Apple® AppleTalk®
Internet Router
Administrator's Guide

APPLE COMPUTER, INC.

This manual and the software described in it are copyrighted, with all rights reserved. Under the copyright laws, neither this manual nor the software may be copied, in whole or in part, without written consent of Apple, except in the normal use of the software or to make a backup copy of the software. The same proprietary and copyright notices must be affixed to any permitted copies as were affixed to the original. This exception does not allow copies to be made for others, whether or not sold, but all of the material purchased (with all backup copies) may be sold, given, or loaned to another person. Under the law, copying includes translating into another language or format.

You may use the software on any computer owned by you, but extra copies cannot be made for this purpose.

© Apple Computer, Inc., 1989
20525 Mariani Avenue
Cupertino, CA 95014
(408) 996-1010

Apple, the Apple logo, AppleShare, AppleTalk, ImageWriter, LaserWriter, and Macintosh are registered trademarks of Apple Computer, Inc.

EtherTalk, Finder, Inter•Poll, LocalTalk, and TokenTalk are trademarks of Apple Computer, Inc.

MacDraw is a registered trademark of Claris Corporation.

Contents

Figures and tables

Preface About This Guide
- Who should read this guide
- How to use this guide
  - If you're new to routers
  - If you're experienced with routers
- Selecting a network administrator
- Additional references

Part I Introduction and System Requirements

1 The AppleTalk Internet Router
- How the AppleTalk Internet Router works
  - Network connections on your router
- What the AppleTalk Internet Router can do
  - Internet routing functions
  - Router control and monitoring functions
- Bridges and routers

2 AppleTalk Terms and Concepts

AppleTalk networks and internets
- Network
- Internet
- The AppleTalk Network System
- Network services
- AppleTalk addressing
  - Packets
  - Nodes
  - Network addresses
  - Node addresses
- AppleTalk zones
  - Zone names and zone lists
  - An internet zone example

Internet routers
- Hardware-based and software-based routers
- Seed routers
- Hops
- Routing tables

3 System Requirements and Router Environments

System requirements
- Hardware
- Software

Macintosh router environments
- Running the AppleTalk Internet Router on a nondedicated Macintosh computer
- Running the AppleTalk Internet Router on a dedicated Macintosh computer
- Running the AppleTalk Internet Router on a Macintosh workstation

Connecting networks to the router ports
- Ports

4 A quick tour

The Router desk accessory
The Router Setup window
The Network Information window
The Port Statistics window
Router operation

Part II Installing and Using the AppleTalk Internet Router

5 Installing the AppleTalk Internet Router

The AppleTalk Internet Router disk
Installing on a hard disk
Installing the AppleTalk Internet Router with an AppleShare file server
  Shutting down AppleShare when the router is active
Running the AppleTalk Internet Router without a hard disk
Changes in the Macintosh Control Panel
Effects of installing the router software on a Macintosh

6 Setting Up the AppleTalk Internet Router

Working in the Router Setup window
  Setting the display
  Moving the cursor in the Router Setup window
  Entering text
Identifying connected networks
  Network numbers and ranges
    Selecting a network range
    Entering a network number or range
    Network numbers on nonseed ports
  Zone names and zone lists
    Entering zone names in a zone list
  The port description
  The User's Port
  Port status
  Entering a name for the router
Starting the router
  Router status settings
  Saving the router setup and restarting
  Selecting a zone for the router

7 Making Changes in the Router's Setup

Making changes while the router is active
  Changing port status
  Changing router status

Making changes while the router is inactive
Changing the User's Port
Adding or deleting a port
Changing port status
Changing the network number or range
Changing a network's zone name or zone list
Changing a port description
Changing router status

8 The Network Information Window
Router activity readings
Packets Routed
Recent Activity Rate
Network Reliability
Recent Network Error Rate
The routing table
Selecting the display style
Selecting the numeric display format
Selecting the sorting order of the routing table
Selecting the sort direction
The routing table display
Routing information
Network Range
Zone Name
Distance
Forwarding Port
Next Router

9 The Port Statistics Window
Interpreting network statistics
Router activity readings
Statistical listings
Packets In
Packets Out
Name Requests In
Name LookUps Out
Data Link Errors
Packet Buffer Overflow

Unknown Network
Hop Count Exceeded
Routing Table Overflow
Local Network Number Conflict
Nonlocal Network Number Conflict
Router version mismatch
Resetting the statistics

10 Router Administration
Reset All Statistics
Change Settings
Network and node number format
Decimal
Hexadecimal
Network information sorting order
Ascending
Descending
Network information view
Summary view
Detail view
Set password
Changing your password
Canceling password protection
Print Current Window

11 Troubleshooting
Problems with your network system
Recognizing network-related problems
Common network-related problems
Where to find network troubleshooting information
Problems with the AppleTalk Internet Router
Recognizing router-related problems
Errors in router setup
Error messages at startup
Error messages in the Router desk accessory

Appendixes

Appendix A
Planning an AppleTalk Internet

When do you need to create an internet?
Planning the physical layout of an internet
- Creating a map
- Backbone networks
  - Selecting the backbone network type

Where to place a router
- Selecting a router location on each network
- Creating redundant routes
- Adding backbone networks
- Relative network speed

Assigning network numbers, ranges, and zones
- Assigning network numbers
- Assigning network ranges
- Creating AppleTalk zones
  - Creating zones to balance network services in the internet
  - Creating zones to facilitate departmental grouping

Appendix B
Effects of the AppleTalk Internet Router on Network Nodes

Connecting a node to a network
Reestablishing a node's AppleTalk connection
Selecting a node's zone

Figures and tables

PREFACE **About This Guide**

Figure P-1 How to use this guide

CHAPTER 1 **The AppleTalk Internet Router**

Figure 1-1 Connecting multiple network media on a Macintosh II router
Figure 1-2 Bridges and routers on an internet
Table 1-1 Possible Macintosh network connections

CHAPTER 2 **AppleTalk Terms and Concepts**

Figure 2-1 Nodes on a network can reside in different zones
Figure 2-2 Using seed routers to simplify the router setup procedure
Figure 2-3 Hops in an internet route

CHAPTER 4 **A quick tour**

Figure 4-1 The Router menu
Figure 4-2 The Router Setup window
Figure 4-3 The Network Information window
Figure 4-4 The Port Statistics window

CHAPTER 5 **A quick tour**

Figure 5-1 The Installer dialog box
Figure 5-2 The shutdown warning dialog box

Figure 5-3 The Macintosh Control Panel after installation of the AppleTalk Internet Router and EtherTalk and TokenTalk drivers

CHAPTER 6 **Setting Up the AppleTalk Internet Router**

Figure 6-1 The Router Setup window
Figure 6-2 The Zone List dialog box
Figure 6-3 The Setup window's router status settings
Table 6-1 Cursor control keys
Table 6-2 Router status settings

CHAPTER 8 **The Network Information Window**

Figure 8-1 The Network Information window
Figure 8-2 The sort selection pop-up menu, closed and open
Figure 8-3 The Forwarding Port and Next Router in an internet route
Table 8-1 Routing table viewing options

CHAPTER 9 **The Network Information Window**

Figure 9-1 The Port Statistics window

CHAPTER 10 **Router Administration**

Figure 10-1 The Router menu
Figure 10-2 The Settings dialog box
Figure 10-3 The Set Password dialog box
Figure 10-4 The Change Password dialog box
Figure 10-5 The Print dialog box for a LaserWriter

APPENDIX A **Planning an AppleTalk Internet**

Figure A-1 How a backbone network is used
Figure A-2 Sample router locations
Figure A-3 A redundant route layout
Figure A-4 Network independence through backbone design
Figure A-5 Laying out the internet for optimum performance
Figure A-6 How some redundant routes can interfere with routing efficiency
Figure A-7 Balancing services through AppleTalk zones
Figure A-8 How zones help users on different physical networks share services
Table A-1 A sample network numbering system

P R E F A C E

About This Guide

THIS GUIDE CONTAINS INSTRUCTIONS FOR INSTALLING AND OPERATING THE AppleTalk® Internet Router.

A **router** is a device that connects two or more networks, allowing the network system to grow beyond the size limits of a single network, and improving performance by isolating local traffic on each connected network.

The AppleTalk Internet Router software runs on a Macintosh® computer that can concurrently provide other network services. The Macintosh router can connect up to eight AppleTalk networks.

The AppleTalk Internet Router serves two main functions on an AppleTalk network system:

- It enables a Macintosh computer to perform internet routing, in many cases concurrently with other network services, and provides the familiar Macintosh user interface for router setup and control.
- It provides information to the network administrator about internetwork routes, network activity levels, and error statistics on the network system.

The AppleTalk Internet Router is a component of AppleTalk Phase 2, and may be used only on an internet in which all routers are compatible with AppleTalk Phase 2.

Who should read this guide

This guide was designed for administrators of AppleTalk network systems.

The technical contents of the guide are written for a reader with basic computer experience; the reader is not required to have prior knowledge of network administration. Some of the material is relatively technical, but no new concepts are introduced without explanation.

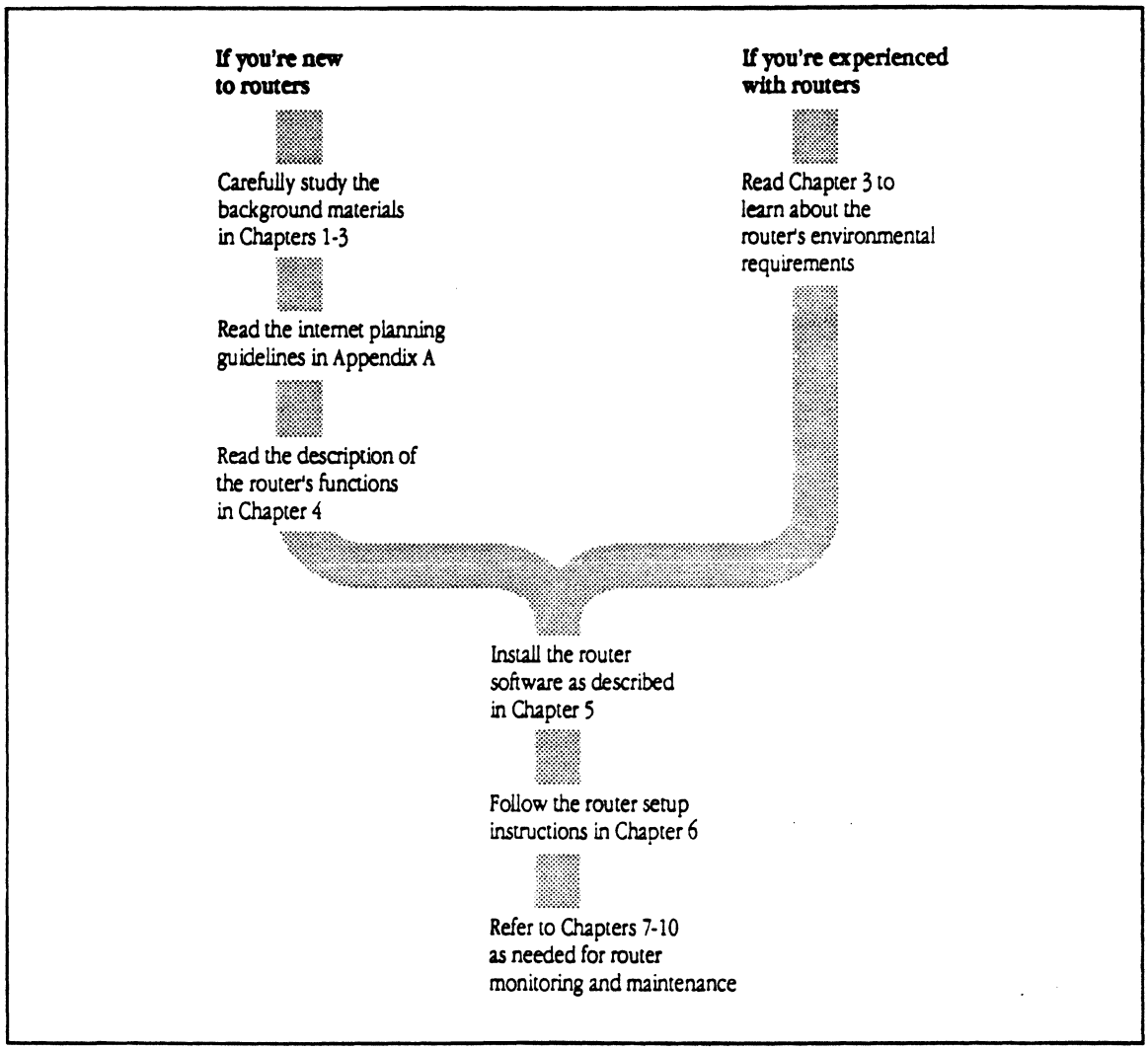
Macintosh experience is assumed, so concepts such as selecting text or using the mouse are not covered explicitly. If you need assistance with Macintosh concepts not covered here, refer to the owner's guide and the system software guide for your Macintosh computer.

How to use this guide

This manual begins with basic concepts and proceeds to explicit instructions. An experienced network administrator may spend less time on introductory chapters and move quickly to operating instructions; however, it is important for any administrator of the AppleTalk Internet Router to become familiar with AppleTalk concepts and terms, such as *zones* and *internets*, as these are central to understanding router services.

Figure P-1 illustrates the sequence in which users having different levels of experience should read this guide.

■ **Figure P-1** How to use this guide



If you're new to routers

If you haven't previously set up an AppleTalk router, then you will require an introduction to the AppleTalk network system and networking concepts before installing the router:

- Carefully study the background materials in Chapters 1 through 3.
- Read the internet planning guidelines in Appendix A.
- Read the description of the router's functionality in Chapter 4.
- Install the router software as described in Chapter 5.
- Follow the router setup instructions in Chapter 6.
- Refer to Chapters 7 through 10 for router monitoring and maintenance.

If you're experienced with routers

If you're already familiar with AppleTalk concepts and terminology and have experience with internets and routers:

- Read Chapter 3 to learn about the router's environmental requirements.
- Install the router software as described in Chapter 5.
- Follow the router setup instructions in Chapter 6.
- Refer to Chapters 7 through 10 for router monitoring and maintenance.

Selecting a network administrator

Installing and administering the AppleTalk Internet Router requires the selection of a *network administrator* who is responsible for maintaining the network system. If a network administrator has not yet been designated for your network, it's recommended that one be chosen before proceeding.

The responsibilities of the network administrator include some or all of the following tasks:

- participate in planning the physical layout of the network system
- plan the placement of routers, set up routers, and assign network identification numbers
- coordinate the addition, removal, and relocation of devices on the internet, such as computers, printers, and servers
- develop and maintain a current map of the network cabling layout and device locations
- coordinate the selection and implementation of network services, such as file servers and electronic mail facilities
- perform regular preventive maintenance to help ensure continuous network operation
- troubleshoot malfunctioning network devices and problems in the cable system

The network administrator must be familiar with Macintosh operation and will benefit from prior training in hardware, software, or data communication. However, for the purposes of administering the AppleTalk Internet Router, the network administrator is not required to have any specific technical background.

Additional references

The following manuals available from Apple Computer, Inc., provide additional information about using AppleTalk networks:

- The *Inter•Poll Administrator's Guide* describes how to use the Inter•Poll™ network administrator's utility for maintenance and troubleshooting on an AppleTalk network system.
- The *LocalTalk Cable System Guide* is a brief reference guide to LocalTalk™ cable, hardware, and installation. Use it to help in the initial setup of your network and as a basic introduction to LocalTalk networks.
- The *Apple EtherTalk NB User's Guide* provides installation and operation guidelines for those using EtherTalk™ in their AppleTalk network system.
- The *Apple TokenTalk NB User's Guide* provides installation and operation guidelines for those using TokenTalk™ in their AppleTalk network system.
- *Inside AppleTalk* is the technical reference manual that explicitly describes AppleTalk network protocols.
- The *AppleTalk Network System Overview* provides an introduction to the AppleTalk network system architecture and AppleTalk protocols.

Part I

Introduction and System Requirements

CHAPTER 1

The AppleTalk Internet Router

WHAT A NETWORK CAN DO FOR INDIVIDUAL COMPUTER USERS, AN INTERNET router can do for network users: It connects computer networks together, allowing users on different networks to communicate with each other, to share information, and to share network services such as printing and electronic mail.

The AppleTalk Internet Router software enables a Macintosh® computer to serve as an internet router, through which multiple AppleTalk® networks can be connected, forming an **internet.** LocalTalk®, EtherTalk™, and TokenTalk™ networks can be interconnected using an AppleTalk Internet Router.

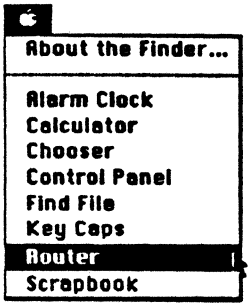
The AppleTalk Internet Router is an integral component of the AppleTalk network system. It implements the AppleTalk **protocols,** or rules, that manage the addressing and routing of information to permit internetwork communication.

How the AppleTalk Internet Router works

The Macintosh computer used as a router directs traffic among connected networks. To do this, the router software acquires and maintains an up-to-date list of all the networks in the internet, as well as the addresses of other routers through which to forward traffic toward its proper destination.

The AppleTalk Internet Router is administered using a Macintosh desk accessory named Router. The network administrator uses this desk accessory to set up the router and to monitor its operation. The Router desk accessory appears in the Apple menu after the router software is installed.

Depending on the Macintosh computer being used as a router, you can connect from two to eight AppleTalk networks to the router, using a combination of the Macintosh serial ports and added internal interface cards. These network connections include LocalTalk™, EtherTalk™, and TokenTalk™ networks, and any other network types for which Macintosh AppleTalk connections become available in the future.



The Router desk accessory appears in the Apple menu after installation of the router software.

Network connections on your router

Table 1-1 shows configurations of LocalTalk, EtherTalk, and TokenTalk network connections typically available on the Macintosh computers listed.

Other network connections, such as an Ethernet connection for the Macintosh SE, may also be supported, but these are not covered by this document. The AppleTalk Internet Router will support any network connection developed in conformance with Macintosh AppleTalk connection guidelines.

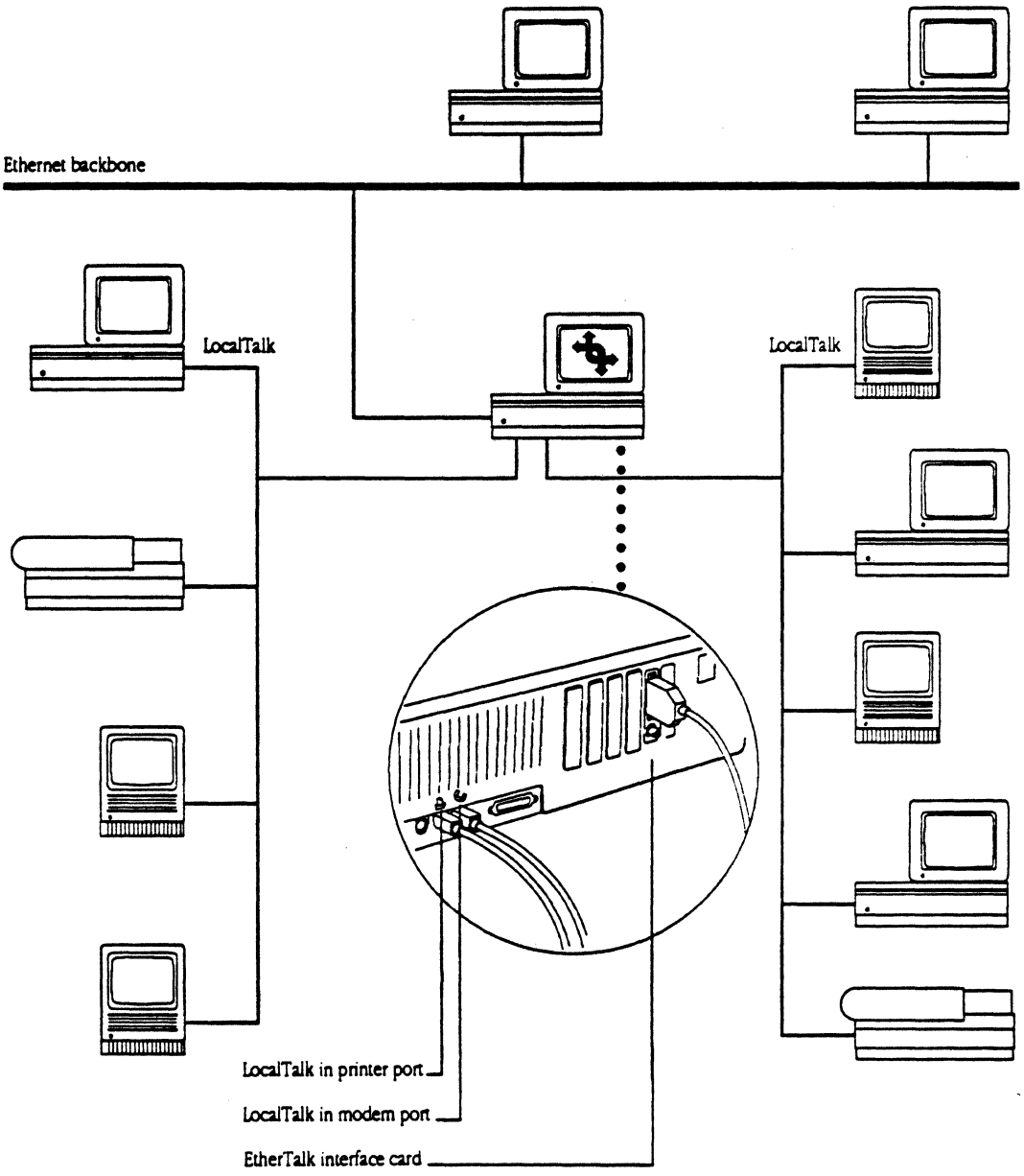
■ **Table 1-1** Possible Macintosh network connections

Connection	Macintosh Plus	Macintosh SE or SE/30	Macintosh II or IIx	Macintosh IIcx
LocalTalk	2	2	2	2
EtherTalk	0*	0*	6	3
TokenTalk	0	0	6	3
Maximum connections	2*	2*	8	5

* EtherTalk interface cards for these Macintosh models may be available from independent vendors, making an additional network connection possible on routers using these computers.

On the following page, Figure 1-1 illustrates how an AppleTalk Internet Router can be used to connect different network types having different cable systems.

■ **Figure 1-1** Connecting multiple network media on a Macintosh II router



What the AppleTalk Internet Router can do

The AppleTalk Internet Router provides two categories of functions:

- *internet routing*, performed in the "background" (or invisibly to the user) on a Macintosh computer
- *router control and monitoring*, performed interactively through the Router desk accessory

Internet routing functions

The AppleTalk Internet Router performs the following functions on an AppleTalk network system:

- increases the potential size and number of devices in the network system by connecting multiple networks together
- connects different AppleTalk network types, such as LocalTalk, EtherTalk, and TokenTalk
- improves internet performance by isolating local traffic within individual networks
- creates **zones** that conceptually partition the internet, so that users can more efficiently access shared services

Router control and monitoring functions

A network administrator will use the Router desk accessory for three types of activities:

- setting up the router
- viewing network routing information
- viewing network statistics

Router Setup: The Router Setup window allows you to identify the networks connected to the Macintosh router's ports, and to create internet zones that can be used to group devices on those networks. Up to eight directly connected networks can be defined in the Router Setup window.

Network Information: The router's Network Information window displays general router activity levels as well as the current routing table of the internet, listing networks, zones, and routing information for the entire internet.

Port Statistics: The router's Port Stastistics window displays both general routing activity and a port-by-port statistical description of various operating conditions and errors on the internet.

Additional functions of the Router desk accessory allow you to set options for viewing routing information, and to print out the various router displays.

Bridges and routers

The terms *bridge* and *router* have often been used interchangeably in networking literature. Both bridges and routers are used to interconnect networks and move information between them, but the differences between these devices need to be clarified.

- *Note:* In some previous documents from Apple, the term *bridge* has been used generically to refer to bridges and routers. This and future documents from Apple will use the terms *bridge* and *router* distinctly.

The difference between bridges and routers can be summarized as follows:

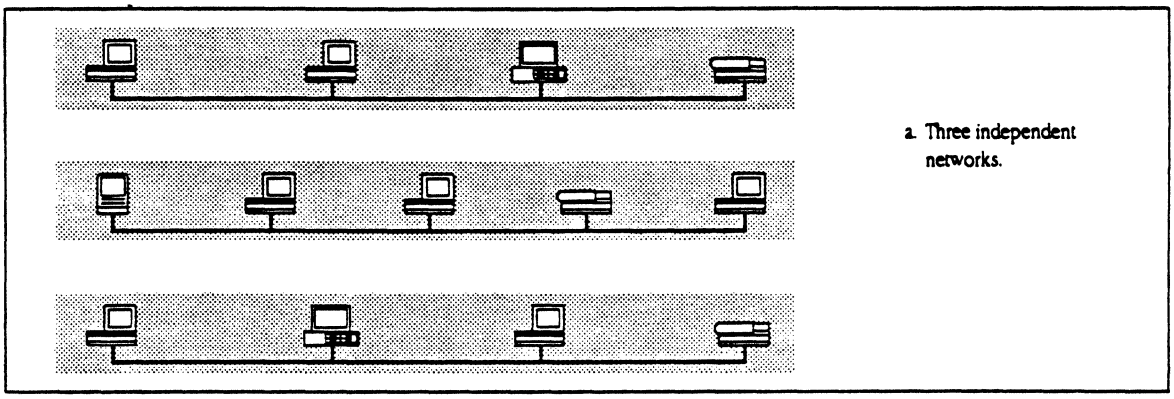
When a **bridge** is used to join two networks, the result is one expanded network, not an internet. The bridge causes the previously separate networks to *appear* to any other connected networks as a single network.

A **router,** however, maintains a logical map of the networks and other routers in an internet, enabling the networks to retain separate identities, and enabling the router to determine the most efficient path through which to transmit data to its destination network.

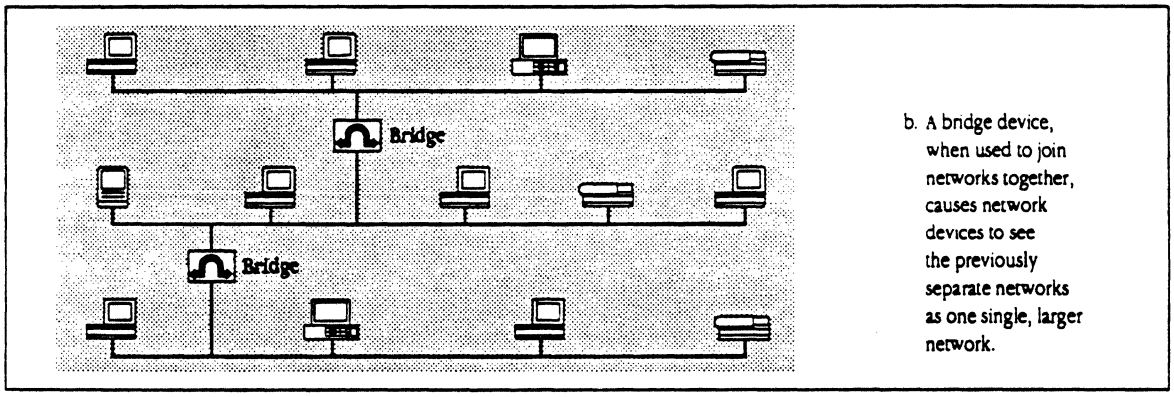
For readers familiar with the terminology of network protocols, a bridge implements the addressing of nodes on connected networks at the *data-link* protocol level, while a router supports addressing at the *network* protocol level.

Figure 1-2 illustrates the distinction between bridges and routers.

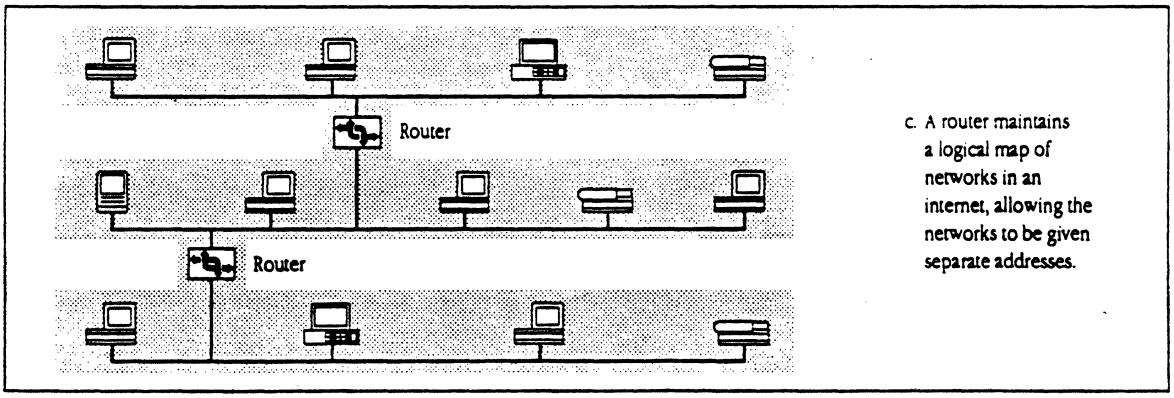
■ **Figure 1-2** Bridges and routers on an internet



a. Three independent networks.



b. A bridge device, when used to join networks together, causes network devices to see the previously separate networks as one single, larger network.



c. A router maintains a logical map of networks in an internet, allowing the networks to be given separate addresses.

CHAPTER 2

AppleTalk Terms and Concepts

BEFORE YOU INSTALL AND USE THE APPLETALK INTERNET ROUTER, YOU should be familiar with some of the fundamental terms and concepts of AppleTalk network systems. The definitions in this chapter will help you to understand the router's operating principles and the information in its displays.

AppleTalk networks and internets

If you have no prior experience with the AppleTalk network system, be sure to study all the concepts in this chapter before proceeding. If you are experienced with AppleTalk, but not familiar with the extended features of AppleTalk Phase 2, read the sections of this chapter titled "AppleTalk Addressing" and "AppleTalk Zones."

Network

A network is a collection of computers, server devices, and connecting devices that are connected together and capable of communicating with each other through a transmission medium.

Examples of transmission media include electrical cables, optical fibers, and telephone lines.

For the purposes of this manual, a network is defined as having a unique identity separate from any other network(s) to which it is connected (see "AppleTalk Addressing," below).

Internet

An internet is any grouping of two or more networks connected by one or more internet routers.

The AppleTalk Network System

A **network system** is a communication environment in which network devices and software observe a common set of rules for communicating. These rules are called network **protocols**, and they explicitly prescribe each step in the process of interaction between network devices.

The AppleTalk network system comprises a set of protocols, each of which governs a different aspect of the communication process, such as how network devices are identified, and how data is formatted for transmission. AppleTalk protcols can be implemented by a wide variety of different devices and transmission media.

While all AppleTalk networks use AppleTalk protocols, they do not all use the same transmission standards, media, or connections.

The AppleTalk network system's design allows you to select the cable systems that best suit the needs of your installation, while retaining the same AppleTalk services and interface throughout the internet. Every Macintosh computer is equipped with a built-in LocalTalk network connection, which supports the low-cost, medium-speed LocalTalk cable system.

Alternate network connections include EtherTalk, for the higher performance of the Ethernet network standard, and TokenTalk, for connection to a Token Ring network. These network connections are available through special interface cards in certain Macintosh computers. (See the discussion of network connections at the end of Chapter 3.)

Network services

AppleTalk network services are the capabilities that the network system delivers to users, such as printing on network printers, file sharing on network file servers, or communicating through electronic mail.

AppleTalk addressing

Transmitting information in an AppleTalk network system—for example, a request from a workstation to open a file on a server—is made possible by an addressing scheme that identifies the sender and destination of the transmission, using network and node **addresses.** Data is transmitted to and from these addresses in the form of **Packets.**

Packets

To prepare data for transmission, AppleTalk network software formats the data into packets, adding the addresses of the source and destination devices. A **packet** is one unit of information that has been formatted for transmission on an AppleTalk network.

AppleTalk packets vary in length from a few characters to a few hundred. A short network transmission might fit into a single packet, while a longer transmission, such as a document file, will usually be broken up into multiple packets.

Some of the packets transmitted on a network are sent not by users, but by network software implementing AppleTalk protocols; for example, the exchange of network information among routers updating each other's routing tables.

Nodes

Each individually addressable device connected to an AppleTalk network, such as a computer or a LaserWriter® printer, is known as a **node.**

- A LocalTalk network can support up to 32 nodes.
- An EtherTalk or TokenTalk network can support over 16 million node addresses. The actual maximum number of devices is determined by physical limitations of the network.

Network addresses

An AppleTalk network is identified by either a **network number** or a **network range.** These identifiers are defined during the router setup process.

- A LocalTalk network is identified by a single network number that is unique in the internet.
- All other AppleTalk networks are identified by a *network range*—a range of contiguous network numbers, such as 1–10. (If EtherTalk is installed on your router, the EtherTalk software must be upgraded to version 2.0 to support network ranges.)

The network number or range must be unique in the internet: no two networks can have the same number, and no two network ranges can overlap or have any network numbers in common.

Each number in a network range is a network address that can be associated with up to 253 nodes. The size of the network range determines the maximum number of AppleTalk devices on the physical network. For example, a network having the range 1–10 could contain up to 10 x 253, or 2,530 nodes.

Chapter 6, "Setting Up the AppleTalk Internet Router," describes the procedure for entering network numbers and ranges, and Appendix A, "Planning an AppleTalk Internet," provides additional information about choosing network numbers and network ranges.

Node addresses

Each individual node on an AppleTalk network is identified by a **node address.** A node address consists of

- a network number
- a node number, known as the **node ID**

On a network identified by a network range, the first part of each node's address—the *network number* portion—is a number within that network range. For example, a network having the range 1–10 would contain nodes with such addresses as 1,96 or 5,77.

An AppleTalk node automatically acquires an address when it is turned on; the address does not need to be assigned by an administrator or user.

Since node addresses are dynamically assigned in this way upon startup, a node may or may not have the same address each time it is turned on. When restarted, a node attempts to reclaim the address it previously used. If, while the node was off, its address was acquired by another, the node will acquire a new address.

AppleTalk zones

A **zone** in an AppleTalk internet is a means of grouping devices that makes it easier to locate and access network services. AppleTalk zones are conceptual groupings with no physical boundaries; they are defined by the network administrator during the router setup process.

Each node in an AppleTalk internet belongs to one specific zone. Network services delivered by these nodes, such as printing and file service, are presented to users in listings grouped by zone name.

To view or use any service in an AppleTalk internet, a user first selects a zone from a list and then indicates the type of service desired. The user is then presented with a list of all available services of the desired type *within the selected zone only*, eliminating the need to search through combined listings of all services on the internet at once.

Defining zones can facilitate the departmental grouping of users. Since nodes on different networks can belong to the same zone, and nodes on the same network can belong to different zones, zones let you create and modify work groups without changing any physical connections. An AppleTalk internet can contain any number of zones.

Zone names and zone lists

During the router setup process, each network connected to the router is identified, and can be associated with one or more **zone names.**

- A LocalTalk network can be associated with only *one* zone name. All of the network's nodes belong to this zone.
- All other AppleTalk networks can be associated with a **zone list**—a list of one or more zone names available to nodes on that network.

The zone to which an individual node belongs can be chosen from among the zone names associated with that node's network. This list of zones can be accessed through the Macintosh Control Panel. Unless a node's zone is explicitly selected from the network's zone list, the node belongs to the **default zone** for the network, which is defined during router setup.

A node can belong to only one zone, but the node's user can view and access network services, such as printers and file servers, in all zones.

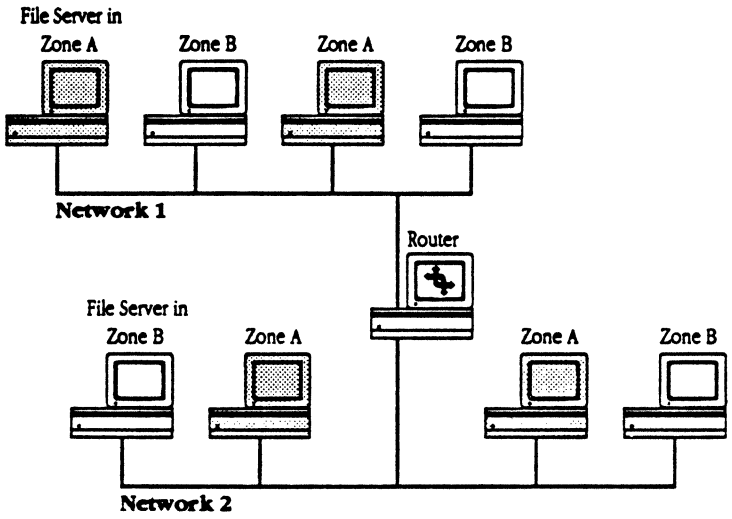
It's important to distinguish between the *internet zone list*—the list of all zones in the internet from which you can access network services—and the *network zone list* from which you select the zone to which a node will belong. The internet zone list is presented in the Macintosh Chooser desk accessory, while the network zone list is accessed through the Control Panel.

If only one zone is defined for the entire internet, all network services in the internet are presented together in each Macintosh user's Chooser window, and *no* zone name is displayed.

An internet zone example

It's useful to remember that AppleTalk zones are groupings of computers and services defined for organizational purposes, *not* physical arrangements of devices. Figure 2-1 illustrates this concept: If you connect two networks to a router and enter the same two zones—Zone A and Zone B—in the zone list for each network, either Zone A or Zone B can be selected as the zone in which to register *any node*.

■ **Figure 2-1** Nodes on a network can reside in different zones.



Some key points to remember about zones:

- There is no physical size or shape to a zone; it can include one node, several, or all the nodes on the entire internet.
- It isn't necessary for nodes that belong to the same zone to be physically contiguous, or on the same network, or even on contiguous networks.
- Any node in a network can belong to any zone whose name appears in that network's zone list.
- A LocalTalk network's zone list can contain only one zone name.

Internet routers

An internet router is used to connect an AppleTalk network to one or more additional AppleTalk networks. The following are general aspects of internet routers for the AppleTalk network system.

Hardware-based and software-based routers

A hardware-based router is a dedicated device whose only function is internet routing. It is generally a self-contained device, without a monitor or keyboard, designed to be used only as a router.

A software-based router operates on a general-purpose computer, and may be a **dedicated** on **nondedicated** router.

A dedicated router is a computer which, when running internet routing software, can be used for no other purpose. The AppleTalk Internet Router is an example of a nondedicated, software-based router. It operates on a Macintosh computer that may be used concurrently for other network services, eliminating the need to dedicate a computer to either the router or server.

Seed routers

When more than one router is connected to an AppleTalk network, the identifying information for that network, such as its network range and zone list, needs to be entered in only *one* of the connected routers.

A router in which this identifying information about a network is defined is said to be a **seed router** for that network. A network must have at least one seed router.

A seed router transmits identifying information about the network to all other routers directly connected to that network. A **nonseed router** is a router in which information about a network is *not* entered by the network administrator. Nonseed routers acquire network information from seed routers.

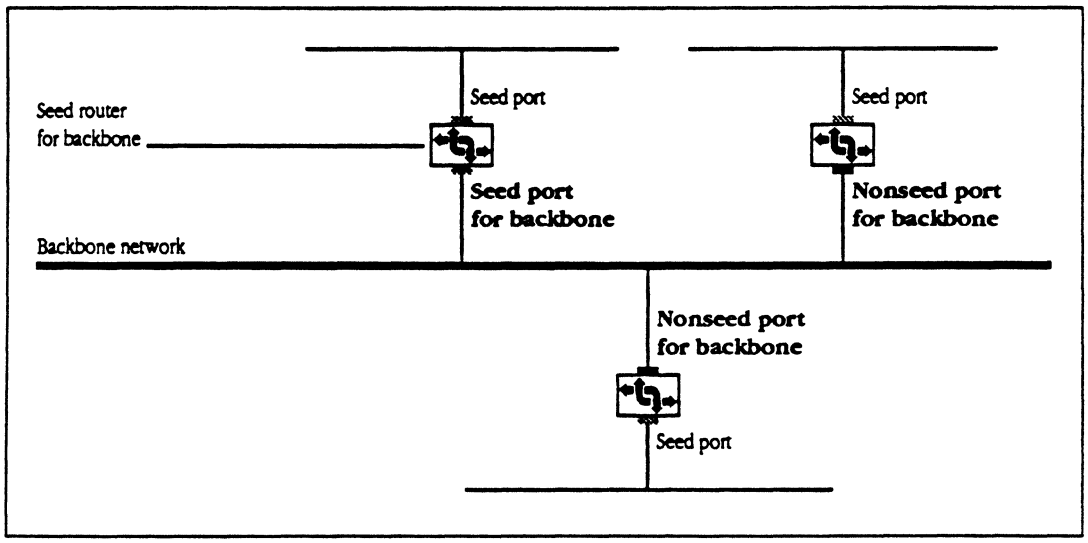
Seed routers make it possible for you to enter setup information for a network only once, no matter how many routers are connected to that network. This capability eliminates the need to enter the same information in several routers, thereby reducing the risk of conflicts due to mistyped network information.

While setting up a router, you need to enter network numbers and zone names for only those networks for which the router is a seed router. An example of this is shown in Figure 2-2.

- *Note:* Any router may be both a seed and nonseed router for different connected networks. For example, a router with connections to four networks might serve as a seed router for two of these and as a nonseed router for the remaining two.

  Because a router can provide seed routing services to some connected networks and nonseed routing services to others, the router's ports are referred to as *seed ports* and *nonseed ports*.

■ **Figure 2-2** Using seed routers to simplify the router setup procedure



A network must have at least one seed router to be recognized by any other internet routers. If two or more routers serve as seed routers for the same network, each must specify the exact same information about the network.

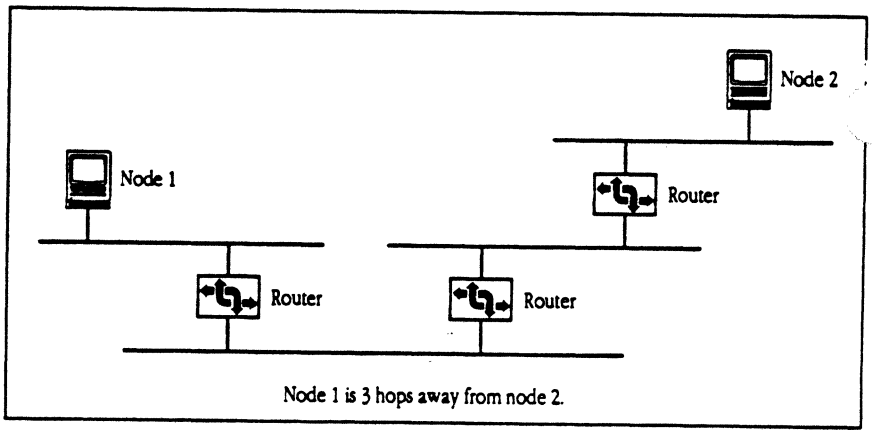
An AppleTalk Internet Router will not recognize any networks connected to nonseed ports until network information is received from the networks' seed routers. This information is acquired during the regular exchange of routing tables among routers on each network (see "Routing Tables," following). In the interim, the networks will not appear in the Network Information displays of nonseed routers.

Hops

A **hop** is a unit count between networks on the internet. A hop signifies "one router away." For example, a network device located on a network separated from your network by three routers would be three hops away.

AppleTalk protocols allow a maximum of 15 hops in any single transmission path.

■ **Figure 2-3** Hops in an internet route



Routing tables

A **routing table** is maintained in each AppleTalk Internet Router. This table lists all networks and routers in the internet, to enable routers to determine the most efficient route for each packet.

The routing table serves the router as a logical map of the internet, specifying the address of the next router in the path to a given destination network, and the distance (in hops) to other networks. The router uses the routing table to determine where (and whether) to forward a data packet.

Each router periodically broadcasts its routing table to other routers on each of its directly connected networks, enabling them to compare and update their own tables with the most recent record of connected networks and routes. In this way, routing tables are kept current as changes are made on the internet.

The routing table maintained by the AppleTalk Internet Router is described in Chapter 8, "The Network Information Window."

CHAPTER 3

System Requirements and Router Environments

THIS CHAPTER TELLS YOU WHAT YOU NEED TO KNOW ABOUT ROUTER hardware, software, and environments. Be sure you're familiar with the information in this chapter before you proceed to install or set up the AppleTalk Internet Router.

System requirements

The following sections specify the hardware and system software required to operate the AppleTalk Internet Router.

Hardware

The AppleTalk Internet Router can be operated on any of the following Macintosh computers:

- Macintosh Plus
- Macintosh SE family
- Macintosh II family

A hard disk is *not* required on the Macintosh computer running the router software.

The AppleTalk Internet Router *cannot* be operated on any of the following computers:

- Macintosh XL
- Macintosh 128K
- Macintosh 512K
- Macintosh 512K enhanced

✥ *Note:* If the AppleTalk Internet Router will be running on a Macintosh concurrently with one other network service, such as file server or print server software, a system with a hard disk and 1 megabyte (MB) of random-access memory (RAM) may be adequate. If more than one additional service is to be provided by the router Macintosh, at least 2 MB of RAM will be required. For details, see "Macintosh Router Environments" later in this chapter.

Software

The Macintosh computer running the AppleTalk Internet Router must be equipped with the following software:

- System file version 6.0.3 or later.
- If a TokenTalk network connection is installed on the router, the TokenTalk software must be version 2.0 or later.
- If an EtherTalk network connection is installed on the router, the EtherTalk software must be version 2.0 or later.

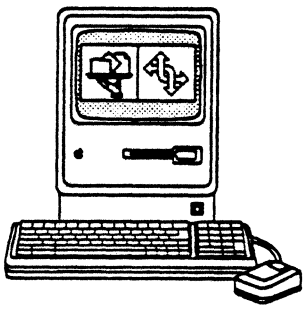
EtherTalk software version 1.2 or earlier can be used *temporarily* in an AppleTalk Internet Router, to retain connectivity during an internet upgrade from AppleTalk Phase 1 to Phase 2. However, such a network connection will not provide the full functionality of AppleTalk Phase 2, and the network will experience lower performance.

Macintosh router environments

As mentioned previously, one of the advantages of a software-based router is the ability to combine the router's services with other network services on a Macintosh computer.

The three most common Macintosh environments for the AppleTalk Internet Router are described on the following pages. The one you find most suitable will depend on the requirements of the internet in which the router is installed.

Running the AppleTalk Internet Router on a nondedicated Macintosh computer



A highly cost-effective use of the AppleTalk Internet Router is to run the router software on a Macintosh computer concurrently with an AppleShare® file server, print server, or both.

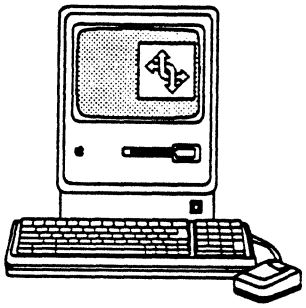
- *Memory requirements:* If both a file server and a print server will be running concurrently with the router, a Macintosh with at least 2 MB of RAM will be required. If either server is individually used with the router, a 1 MB system may be adequate.
- *Installing on a server:* Refer to "Installing the AppleTalk Internet Router with an AppleShare File Server" in Chapter 5 for instructions on installing and operating a router on a Macintosh with AppleShare File Server software.

There are several benefits to running a router and a server on a shared Macintosh computer:

- Since a Macintosh computer used as a server is often a dedicated device, its cost-effectiveness can be extended by adding a router.
- In many cases, the server requires that the Macintosh be in a secured environment and that shutdowns be avoided. These conditions are also ideal for an internet router.
- The addition of router services on an AppleShare server optimizes the availability of the server by placing it at the hub of several connected networks that can directly access the server.
- Since the AppleShare server is not used as a general-purpose workstation, the router's added processing load will not degrade the performance of any user applications.

△ **Important** To be run concurrently with the AppleTalk Internet Router, AppleShare File Server software must have a version number of at least 2.0.1. △

Running the AppleTalk Internet Router on a dedicated Macintosh computer



If your internet environment demands the least possible degradation in the performance of both servers and routers, or if servers are expected to be shut down frequently, you may want to dedicate a Macintosh computer to run exclusively the AppleTalk Internet Router.

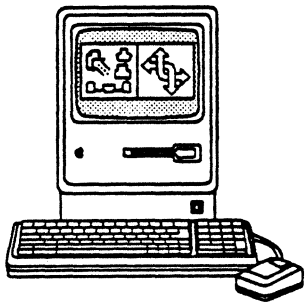
Use the following performance guidelines to determine whether your environment requires a dedicated router.

- If the router is connecting high-traffic LocalTalk networks in a busy internet, the performance of any concurrent server on the router Macintosh may be degraded by router processing.
- An AppleShare file server that is heavily used by many users may degrade the performance of the router and ,consequently, may slow down network performance.
- If the router is connecting EtherTalk or TokenTalk networks, the performance of a concurrent server will *not* be as severely degraded, due to the network interface card's buffering capability, which reduces the central processor's workload.
- An AppleShare print server does not gererate as much input/output traffic as a file server, so network performance is less likely to be degraded by its concurrent use on a router.

A dedicated Macintosh is the router environment that presents your internet with the least risk from interference or degradation in the router device. However, such measures are not necessary in every internet. You may wish to experiment with both dedicated and nondedicated router environments to determine which delivers performance that is appropriate for your needs.

△ **Important** A hard disk is *not* required in a Macintosh computer used as a dedicated router. For further information, see "Running the AppleTalk Internet Router Without a Hard Disk" in Chapter 5. △

Running the AppleTalk Internet Router on a Macintosh workstation



Under most circumstances, an AppleTalk Internet Router should *not* be run on a Macintosh computer that will be used concurrently as a user's workstation. User activities might require shutting down or restarting the system, or might lead to system errors that would interrupt router operation. In addition, user applications on the workstation would suffer from reduced performance due to router processing.

However, a Macintosh router on your network can be designated as an administrator's workstation if its use is limited to providing router services and running network administration software, such as the Inter•Poll™ network administrator's utility. Such administration tools are used only intermittently and may not significantly interfere with router operations.

Again, the actual use and administration patterns in your own network system will dictate the best environments in which to install your routers.

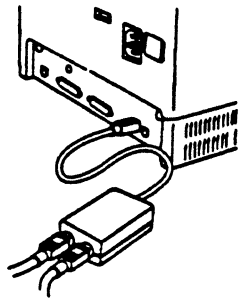
Connecting networks to the router ports

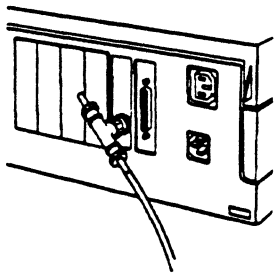
The process of connecting a network to a router port is no different from connecting an AppleTalk network connector to a general-purpose Macintosh computer. However, if you're connecting two LocalTalk networks, you can use both the router's printer and modem ports. The network connections available on your router are described below.

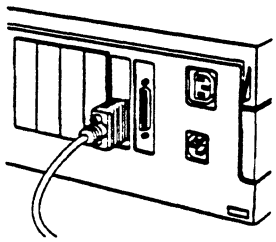
▲ Warning Be sure to shut down the Macintosh running the router software before connecting any networks to its ports. If a concurrent file or print server is running, first perform an orderly shutdown of the application, and then shut down the system. This will shut down any serial network connection software, or *drivers*, running on the Macintosh ports.

Since the Macintosh can be used with serial peripheral devices, such as ImageWriter® printers and modems, it's possible that a driver for such a device will be running on the printer or modem port. These drivers could cause a network-wide malfunction if running when a network is connected to the port. ▲

Ports







Each Macintosh computer is equipped with two standard serial ports: a modem port and a printer port. Both of these ports are used for network connections when the AppleTalk Internet Router is set up as a LocalTalk-to-LocalTalk router.

Additional ports may be added by means of plug-in communication cards. For example, the Macintosh SE accepts one such card, and the Macintosh II accepts up to six. The Macintosh Plus does not accept any added internal interface cards.

- **LocalTalk:** To connect a LocalTalk network, plug the LocalTalk connector directly into the Macintosh printer or modem port. If two LocalTalk networks are being connected, you'll need to use both of these ports.
- **EtherTalk:** To connect one or more Ethernet networks, you'll need to install an EtherTalk interface card into the router Macintosh for each Ethernet connection. Refer to the *Apple EtherTalk NB User's Guide* for complete installation instructions. Then, for each EtherTalk connection, plug the network connector into the port of an installed EtherTalk card.
- **TokenTalk:** To connect one or more Token Ring networks, you'll need to install a TokenTalk interface card into the router Macintosh for each Token Ring connection. Refer to the *Apple TokenTalk NB User's Guide* for complete installation instructions. Then, for each TokenTalk connection, plug the network connector into the port of an installed TokenTalk card.

CHAPTER 4

A quick tour

TO HELP YOU BECOME FAMILIAR WITH THE APPLETALK INTERNET ROUTER, this chapter introduces the router's main features and capabilities:

- the Router desk accessory
- the Router Setup window
- the Network Information window
- the Port Statistics window

Each of these subjects is presented in detail in later chapters.

The Router desk accessory

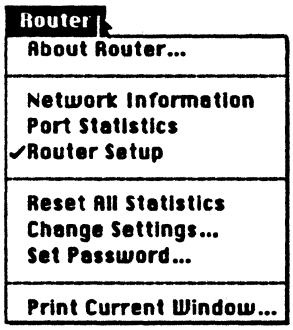
The Router desk accessory is the user interface through which a network administrator can set up and monitor the AppleTalk Internet Router.

The desk accessory represents the visible, external functions of the router software; the actual internet routing operations occur invisibly in the background and continue when the desk accessory is closed.

Choosing the Router desk accessory from the Apple menu causes the Router menu to be added to the menu bar.

Figure 4-1 shows the Router menu's command selections.

■ **Figure 4-1** The Router menu

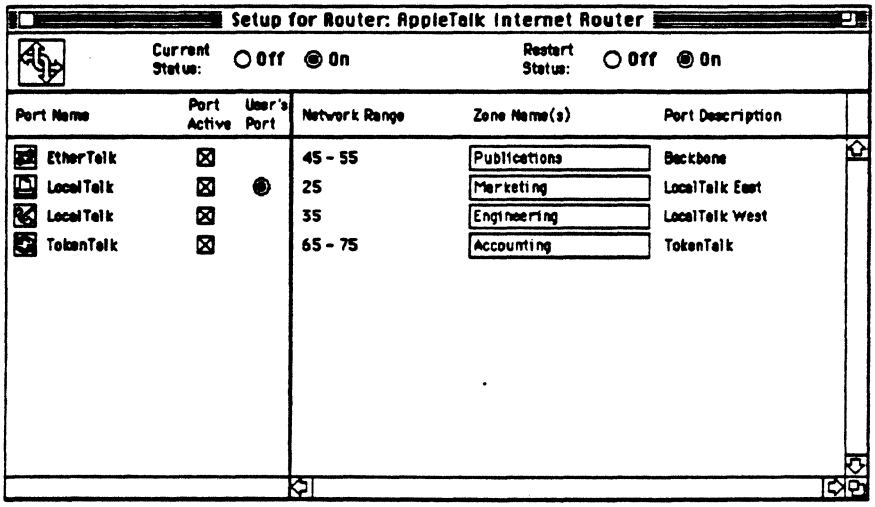


The Router Setup window

The Router Setup window is displayed each time you open the Router desk accessory while the router is not running. (When the router is running, the desk accessory opens to whichever window was most recently displayed.) You can access the Router Setup window anytime through the Router menu.

The Router Setup window, shown in Figure 4-2, is the interface through which you identify each network connected to the router.

■ **Figure 4-2** The Router Setup window



The Router Setup window presents one line for each possible network connection. The number of lines displayed is determined by the number of AppleTalk network ports installed in the Macintosh.

You use the Router Setup window to

- identify each network connected to the router
- create zones to partition the internet
- set the router's on/off status
- make changes in the router's setup

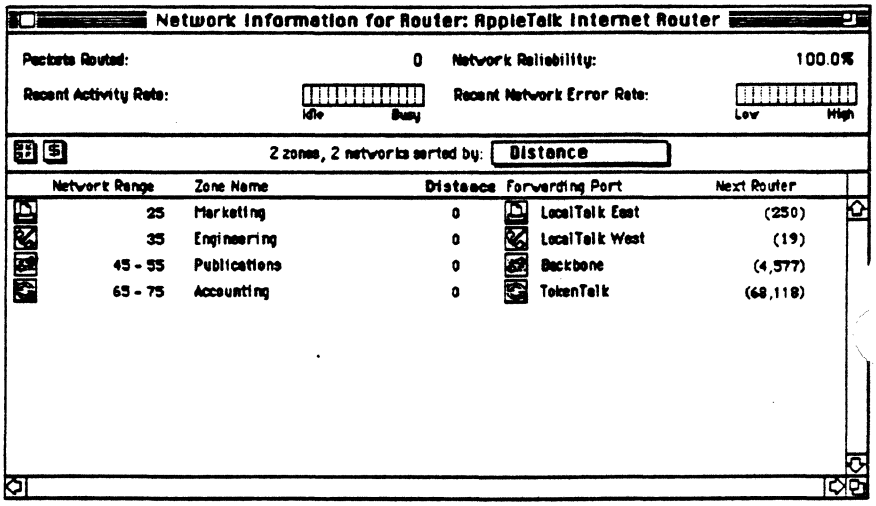
The Router Setup window is described in Chapter 6.

The Network Information window

Once the router is running, you can display the Network Information window, shown in Figure 4-3. This window allows you to monitor

- the level of traffic passing through the router
- the level of network reliability (computed in relation to network errors)
- the current contents of the router's complete routing table, which lists all networks and zones in the internet

Figure 4-3 The Network Information window



The routing table is the foundation of the logic that makes internet routing possible. It is the logical map of the internet that the router uses to forward packets between networks through the most direct route.

The routing table lists the network numbers and zone names of all networks on the internet, the distance in hops to each network from the current router, the router port through which to forward a packet to each network destination, and the address of the next router in the route.

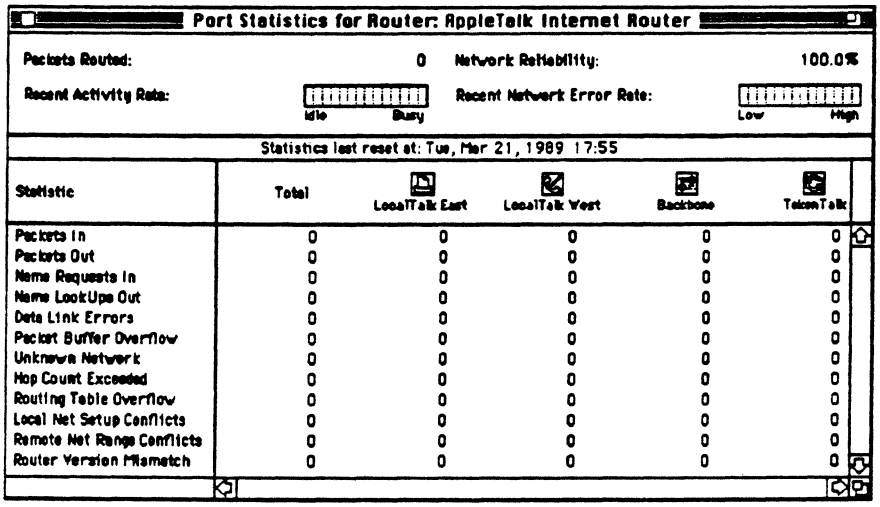
The Network Information window is described in Chapter 8.

The Port Statistics window

While the router is running, you can display the Port Statistics window, shown in Figure 4-4, to observe continually updated totals of

- various significant network errors
- incoming and outgoing traffic rates
- readings of activity and reliability levels

■ **Figure 4-4** The Port Statistics window



The statistics are listed separately for each individual port, so you can monitor relative activity and error levels of connected networks.

The Port Statistics window is described in Chapter 9.

Router operation

Once the AppleTalk Internet Router has been set up, it performs internet routing as a background application and does not require any interactive operation from the user.

The Router desk accesory does not need to be open while the router is running.

The Network Information and Port Statistics windows are provided as your visual interface to the router to allow you to monitor and better understand its activity.

Although no interaction or maintenance is required on your router, you'll turn to these windows often to check the integrity of the router's operation or to help troubleshoot a problem involving a network connection.

Through repeated use of the router's information and statistical displays, you'll acquire a sense of "normal" levels for the various events and errors that are reported, and will come to use this knowledge to interpret imbalances, diagnose related problems, and optimize your internet design.

Part II

Installing and Using the AppleTalk Internet Router

CHAPTER 5

Installing the AppleTalk Internet Router

THIS CHAPTER PROVIDES THE INFORMATION YOU NEED TO INSTALL AND prepare to use the AppleTalk Internet Router. This includes:

- Installing the router software on a hard disk
- Installing the router software on a Macintosh that's concurrently used as an AppleShare file server
- Installing the router software on a Macintosh without a hard disk
- Changes in the Macintosh resulting from the router installation

The AppleTalk Internet Router disk

The AppleTalk Internet Router software is provided on a disk that contains the following items:

- the AppleTalk Internet Router software
- the Router desk accessory
- an Installer application plus installation scripts
- a System Folder

The following sections describe how to install the AppleTalk Internet Router on the startup disk of the Macintosh that will serve as a router.

- *Running from a floppy disk:* If you plan to run the router software on a Macintosh without a hard disk, skip to "Running the AppleTalk Internet Router Without a Hard Disk" later in this chapter.
- *Running with concurrent AppleShare:* If you plan to install the router software on a Macintosh computer that is concurrently used as an AppleShare server, turn to "Installing the AppleTalk Internet Router with an AppleShare File Server," in this chapter, before proceeding.

△ **Important** Be sure that the Macintosh on which you install the router software is located in a place where it will not be inadvertently shut down or used for any unauthorized purpose. △

Installing on a hard disk

To install the AppleTalk Internet Router software on a hard disk:

1. **Start up the Macintosh from the AppleTalk Internet Router disk.**

   Insert the AppleTalk Internet Router disk into the internal disk drive and turn on the Macintosh.

2. **Display the disk's contents.**

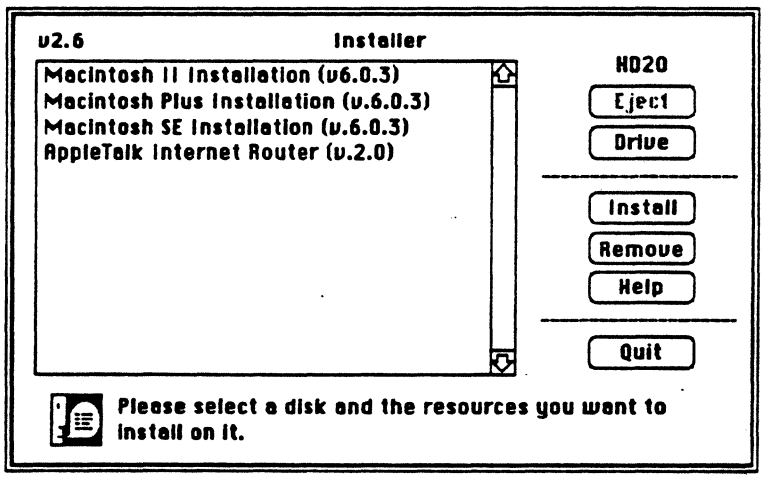
   Double-click the AppleTalk Internet Router Installation disk icon to open the directory window.

3. **Open the Installer.**

   In the AppleTalk Internet Router directory window, double-click the Installer icon to display the Installer dialog box shown in Figure 5-1.

   ❖ *Help:* You can click the Help button in the Installer dialog box, either before or after installing, if you need information about the installation process or the files being installed.

■ **Figure 5-1** The Installer dialog box



4. **Select System installation if necessary.**

   If you're installing onto a blank hard disk with no System Folder, or if your System file is an earlier version than the one provided here, you'll first want to install a new System file. Click the System installation for the appropriate Macintosh computer.

5. **Click Install.**

   System installation begins. This process can take up to two minutes or more, depending on the computer. A message in the Installer dialog box notifies you when installation has been successfully completed.

6. **Install the AppleTalk Internet Router.**

   Click the AppleTalk Internet Router to select it and then click Install once more. The router program and desk accessory will be installed, and you'll be notified by a message when installation has been successfully completed.

7. **Click Quit.**

   The installation is now complete.

8. **Choose Restart from the Special menu.**

   Since the system was started from the router installation disk, you must restart the Macintosh using the startup disk onto which you've installed the router.

   When the Finder™ starts up, the Router desk accessory should appear in the Apple (®) menu. The router is now ready to be set up.

△ **Important** LocalTalk network connection software is installed during the router installation. If you will be using the router to connect EtherTalk or TokenTalk networks, you will need to install the appropriate interface card(s) and network connection drivers on the router Macintosh before setting up the router.

Refer to the EtherTalk or TokenTalk documentation for installation instructions. △

Installing the AppleTalk Internet Router with an AppleShare file server

Use this section when installing the AppleTalk Internet Router software on a Macintosh computer that will concurrently run AppleShare File Server software. Before proceeding, be sure to read the discussion of concurrent applications and their requirements in Chapter 3.

The installation procedure described in the preceding section does not change when the AppleTalk Internet Router software is used concurrently with AppleShare, but it requires additional steps before and after installing the router software.

△ **Important** If AppleShare isn't installed yet, follow the installation instructions in the *AppleShare File Server Administrator's Guide* to install the AppleShare software *before* you install the router.

If the router was installed first, you'll need to reinstall it *after* installing AppleShare. The AppleShare installation causes changes in the System Folder that would prevent the router from running, and these changes are corrected during the router's installation. △

Follow these steps to install the AppleTalk Internet Router after AppleShare has been installed:

1. **If AppleShare is running, perform an orderly shutdown of the server software.**

   Refer to the server documentation for shutdown instructions.

2. **Restart the Macintosh from the AppleTalk Internet Router Installation disk and install the router onto the server's startup volume.**

   Perform the installation exactly as described for a dedicated router in the preceding section.

3. **Restart the Macintosh from the server startup disk onto which you've installed the router.**

   The server is now running, but the router cannot be turned on until it has been set up.

4. **Open the Router desk accessory and proceed to set up the router.**

   Refer to Chapter 6, "Setting Up the AppleTalk Internet Router," for setup instructions.

5. **Set the router's Restart Status to On, save the setup information, and once again shut down the AppleShare server software.**

6. **Restart the Macintosh from the server startup disk onto which you've set up the router.**

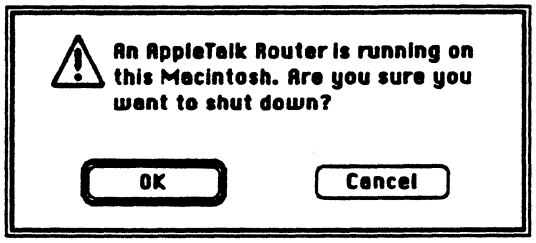
   The AppleShare server and the AppleTalk Internet Router are now running concurrently on the Macintosh.

Shutting down AppleShare when the router is active

To accommodate the users of the file server, AppleShare File Server software provides for a timed countdown period when the system is shut down. This gives users time to finish any work in progress on the server.

An AppleShare dialog box displays a timer that counts down the minutes and seconds until final shutdown. When this timer reaches zero, the server software is shut down. However, if the AppleTalk Internet Router is running, the system does not shut down at this point, but first displays the shutdown warning dialog box shown in Figure 5-2, alerting you that the router is still running.

■ **Figure 5-2** The shutdown warning dialog box



If you click OK to confirm the shutdown command, the system shuts down normally. If you click Cancel at this time, the Macintosh system shutdown is canceled and the router remains active, *but the shutdown of the server is not canceled.*

You can no longer cancel the shutdown of the server at this point because the server has already been shut down. You can continue to use the router, or you can shut down the system at any time. To shut down the Macintosh, choose Shut Down from the Server menu.

Running the AppleTalk Internet Router without a hard disk

The AppleTalk Internet Router can operate without a hard disk. If you choose this configuration, use the procedure below to set up the Macintosh as a router.

- *Installing on a floppy disk* You can install the router software onto a floppy disk. However, this is not necessary if the router will be the only application running on the Macintosh. Running from a copy of the original router disk, as described below, is easier and more direct than using the Installer to install onto a floppy disk.

  If you do wish to install the router software onto a floppy disk, a Macintosh with two floppy disk drives is required. Follow the directions in the previous section for installing on a hard disk, but when you open the Installer dialog box, click the Drive button one or more times until the name of the desired floppy disk drive is displayed. Then continue the procedure as indicated for the hard disk installation.

To run the AppleTalk Internet Router from a copy of the Installation disk:

1. **Make a backup copy of the AppleTalk Internet Router Installation disk.**

   Never use your original disk to run the AppleTalk Internet Router. Make a duplicate disk, referring to your *Macintosh Owner's Guide* if necessary, and store the original disk in a safe place.

2. **Start up your Macintosh from the duplicate router disk.**

   Insert the disk and turn on the Macintosh.

   When the Finder starts up, the Router desk accessory is added to the Apple menu. The router is now ready to be set up.

△ **Important** No printer drivers are included on the AppleTalk Internet Router disk. If you intend to use the Router printing function, you must first install printer drivers onto the System on the AppleTalk Internet Router disk. To make room on the disk, you may need to first remove fonts or desk accessories from the system using the Macintosh Font/DA Mover utility. △

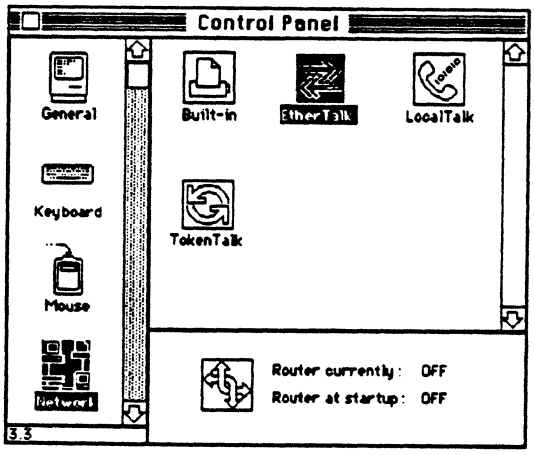
Changes in the Macintosh Control Panel

Once you've installed the AppleTalk Internet Router, you'll note some changes in the Macintosh Control Panel. These changes are produced by files, installed in the Macintosh System Folder during the router installation, that enable the Macintosh to recognize the various AppleTalk connections available.

These files are known as the *Network resource file* and the *AppleTalk connection drivers.*

If you've already had EtherTalk or TokenTalk installed on your system, these files were part of that installation as well. Figure 5-3 shows the Control Panel after the installation of the router, EtherTalk, and TokenTalk.

■ **Figure 5-3** The Macintosh Control Panel after installation of the AppleTalk Internet Router and EtherTalk and TokenTalk drivers



Control Panel resource files produce icons in the Control Panel (for example, the Keyboard and Mouse icons) that allow you to display the corresponding options and settings for these resources.

The Network resource file installed with the AppleTalk Internet Router (as well as with EtherTalk and TokenTalk) produces the Network icon highlighted in Figure 5-3.

When you click the Network icon, the content area of the Control Panel displays an icon for each AppleTalk connection available to the system. The icon for the currently selected AppleTalk connection is highlighted.

Each AppleTalk connection driver displays an icon in the Control Panel. When you click one of these icons, the corresponding AppleTalk connection is established.

One AppleTalk connection driver must be present for each network connection in a Macintosh. For example, if an EtherTalk card is installed, an EtherTalk driver must be installed as well. During the AppleTalk Internet Router installation, the following AppleTalk drivers are added to the System Folder:

- LocalTalk for the Macintosh modem port
- LocalTalk for the Macintosh printer port (labeled "Built-in")

◆ *Note:* Although LocalTalk for the printer port is built into the Macintosh, this additional driver is required for the router to recognize and select the corresponding connection. This file must not be removed from your System Folder as long as the router is installed.

While LocalTalk is normally connected only to the printer port, the router software makes LocalTalk connections available for both the Macintosh printer and modem ports, so that the router can connect two networks without any change in hardware setup.

In addition to resource files and drivers, the router installation adds a status indicator to the Control Panel. When the Network icon is selected, a box is displayed in the Control Panel, indicating whether the router is currently on and whether it is set to turn on upon restart. These settings can be changed in the Router desk accessory but not in the Control Panel.

Effects of installing the router software on a Macintosh

Installing the router software on a Macintosh computer will cause some changes in how you can use the computer.

In addition to the effects on the performance of concurrent applications (discussed in Chapter 3), these changes include:

- The amount of memory available for concurrently running applications is sharply reduced by the router.
- The disk on which the router software is running cannot be ejected or unmounted while the router is active.
- AppleTalk cannot be deactivated from the Chooser when the router is active.
- Attempting to shut down the Macintosh causes a warning to be displayed and requires the shutdown command to be confirmed.
- Once the router software is installed, you cannot change the currently selected AppleTalk connection from the Control Panel, even after the router has been turned off. The router Restart Status must be set to OFF, and the Macintosh restarted, before you can change the AppleTalk connection.

CHAPTER 6

Setting Up the AppleTalk Internet Router

BEFORE YOU CAN START UP AND OPERATE THE APPLETALK INTERNET ROUTER, you need to set up the router by identifying connected networks. The router setup procedure involves

- assigning network numbers and ranges
- defining AppleTalk zones
- entering port descriptions
- selecting a User's Port for the router

▲ Warning Before proceeding, make sure the Macintosh has been restarted using the disk onto which you've installed the router software. This will enable the router setup information you enter to be saved on the that disk. ▲

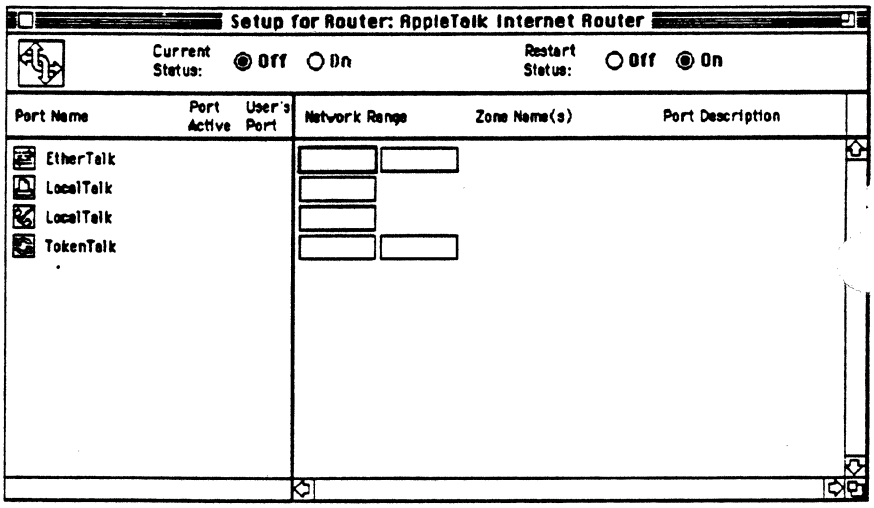
To display the Router Setup window, open the Router desk accessory:

- **Choose Router from the Apple menu.**

  The Router menu is added to your menu bar, and the Router Setup window is displayed on the screen, as shown in Figure 6-1.

The Router Setup window is displayed whenever you open the Router desk accessory while the router is *not* active.

- **Figure 6-1** The Router Setup window



Working in the Router Setup window

The Router Setup window is the interactive portion of the AppleTalk Internet Router software. You can enter and modify the router's setup information using this window, as described below.

Setting the display

Before you enter the port information, determine whether you want the router to display numeric information in decimal notation or hexadecimal (base 16) notation.

If you set the display to hexadecimal (hex), you may still enter decimal values, and vice versa. The entries will be converted for you.

△ **Important** Numbers in hex notation are preceded by a dollar sign when displayed. You must enter them in this format as well. △

To set the numeric display, use the Change Settings command in the Router menu. Changing router settings is described in Chapter 10, "Router Administration."

Moving the cursor in the Router Setup window

To enter port information, you can use the mouse to position the cursor by clicking in any text field. In addition, you can use the key combinations shown in Table 6-1 to move around the Router Setup window.

■ **Table 6-1** Cursor control keys

Keys	Response
Tab	Move to next entry
Shift-Tab	Move to previous entry
Return	Move to next line
Shift-Return	Move to previous line
Enter	

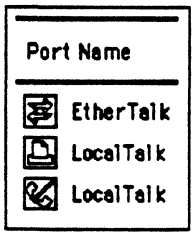
Entering text

You can enter, select, and delete text in the Router Setup window using standard Macintosh editing commands.

The active text field, in which the insertion point is positioned, is always highlighted by a bolder box than the other fields in the window.

Identifying connected networks

The Router Setup window displays one line for each possible network connection, determined by the number of network ports installed in the Macintosh. You should see two LocalTalk port identification lines for the system's modem and printer ports, plus additional lines for ports added on AppleTalk interface cards installed in the router.



Under the Port Name column, you see the identifying icon and the type of each network connection available to you.

For each port that will be connected to a network, you need to enter the requested information as described below.

Network numbers and ranges

You assign a network number or network range to identify each network connected to the router.

- A LocalTalk network is identified by a single network number.
- All other AppleTalk networks are identified by a network range.

A network number can be any number from 1 to 65,279 ($0001 to $FEFF in hex notation). A network range can contain any number of contiguous network numbers.

For a discussion of numbering systems that can be used in the assignment of network numbers, see Appendix A, "Planning an AppleTalk Internet."

Selecting a network range

A network range is a range of network numbers, such as 1–10, that you assign to a single physical network.

Each network number in the range supports up to 253 node addresses. Hence, assigning a network range allows you to multiply the maximum number of nodes allowed on a single physical network by the number of network numbers in the range.

For example, a network having the range 1–10 could contain up to 10 x 253, or 2530 nodes. Node addresses on the network are automatically distributed at random among all the network numbers in the range.

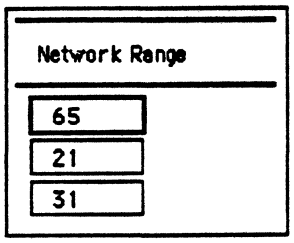
△ Important If a network is never expected to require more than 253 node addresses, you do not need to assign multiple network numbers in its network range. A range containing a single number, such as 45–45, is appropriate. △

For background information about network ranges, refer to Chapter 2, "AppleTalk Terms and Concepts." For a discussion of how to choose a network range, turn to Appendix A, "Planning an AppleTalk Internet."

Entering a network number or range

The network number or range must be entered before any other information can be entered for a network. The blank entry fields in which you enter network information will appear only after you have entered the network number.

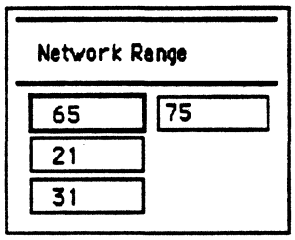
To enter a single network number:



1. **Click in the Network Range field of the port being defined.**
2. **Enter the network number.**
3. **Press Tab to advance to the next field.**

◆ *Note:* If you've entered a decimal number and your display is set to hex (or vice versa), the number will not be converted until you press Tab or Return, or move the cursor with the mouse.

To enter a network range:



1. **Click in the first box of the Network Range field of the port being defined.**
2. **Enter the first (lower) number of the range in the first field.**
3. **Press Tab to advance to the second field.**

   The number you entered is copied into the second field.
4. **If the range contains only one network number (for example 3-3), press Tab again to advance to the Zone name field.**
5. **If the range contains more than one network number, type the higher number of the range in the second field.**
6. **Press Tab to advance to the Zone name field.**

▲ Warning You must not assign the same number to more than one network, or allow numbers in different network ranges to overlap or be duplicated. Only the value zero (indicating a nonseed port) can be assigned to more than one network. ▲

Network numbers on nonseed ports

You can define a port as a nonseed port, provided the network you are defining is also connected to at least one router that is a seed router for that network. The network *must* be connected to at least one seed router, from which all nonseed routers can obtain the network's number or range.

- **To designate a port as a nonseed port, enter a network number of zero for the connected network.**

This is a useful shortcut when setting up many routers and ports, and reduces the chance of error when repeating the same network information on several routers. A detailed discussion of seed and nonseed routers is provided in Chapter 2, "AppleTalk Terms and Concepts."

Zone names and zone lists

You create AppleTalk zones during the router setup process, by entering zone names with which networks will be associated. At least one zone must be defined in an AppleTalk internet.

- A LocalTalk network can be associated with only one zone.
- All other AppleTalk networks can be associated with multiple zone names.

A single zone name can be up to 32 characters long and can contain any characters, numbers, or spaces. The AppleTalk Internet Router supports up to 256 zones in an internet. This is also the maximum number of names in a single zone list. (The 256 zone limit is imposed by the router software; AppleTalk architecture places no limit on the number of zones in an internet.)

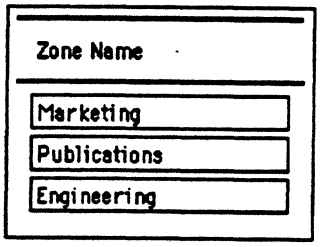
- *Note:* A single asterisk (*) is not allowed as a zone name. This character has special meaning to AppleTalk protocols.

It's a good idea to keep zone names short and simple, because they will appear in other software displays, such as the Chooser, and you'll refer to them often.

△ **Important** If you entered zero for a port's network number, indicating a nonseed port, you must leave the zone name field blank. The zone name will be acquired from a seed router connected to that network. If you entered a nonzero network number, you must enter a zone name or zone list. △

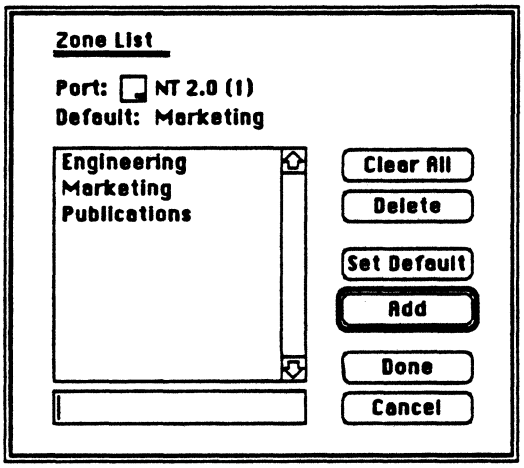
Entering zone names in a zone list

To enter zone names in a zone list:



1. **Click in the Zone Name column (or press Tab from the previous field).**
2. **Enter the first zone name for this network, being careful to type it exactly as it appears in any other router listing.**

■ **Figure 6-2** The Zone List dialog box



3. **Click Add.**

   If the network is a LocalTalk network, only one zone name is allowed. Click Done and skip steps 4 to 6.

4. **Repeat steps 2 and 3 for each additional zone name, if any.**

   If you notice an error after adding a name to the list, click the name in the list, then click Delete to remove it, and reenter the name. The Clear All button removes all names from the list. The Cancel button closes the Zone List dialog box without saving any changes.

5. **Select a default zone, if desired, by clicking the zone name in the list and then clicking Set Default.**

   Each node in the network will be registered in the default zone unless a different zone is selected for that node. For Macintosh nodes, the zone is selected from the node's Control Panel. If you do not designate a default zone, the default zone will be the first zone you enter in the list.

6. **When the list is finished, click Done or press Tab.**

   When you leave the Zone List dialog box, the cursor moves automatically to the next entry field.

When you enter a zone name, the router software recognizes it as the same name whether you use lowercase or uppercase characters. This function of the router is *case insensitive*, meaning that you cannot distinguish zones from one another by using different capitalization.

For more information about zones, refer to Chapter 2, "AppleTalk Terms and Concepts."

The port description

For each of the router's ports, you can assign a description of the connected network to help distinguish the network in the router's displays.

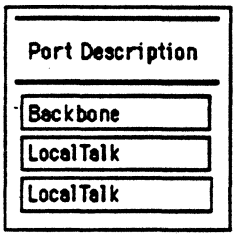
For example, a description for a port connected to a LocalTalk network in a laboratory containing Apple II computers might be "LocalTalk Apple II lab;" a backbone network linking all networks on a floor might be identified as "Third Floor Backbone."

The default entry that appears in the Port Description field is the same as the port name. You may leave this as the port description or enter a new one as described below.

The decision to enter a port description is strictly discretionary. The port description is for your own use and has no meaning to the router software.

The port description can be up to 31 characters long and can contain any characters, numbers, or spaces.

To enter a port description:



1. **Click and drag across the default port description entry to select the text, or press Tab when leaving the previous field.**
2. **Type the new port description.**
3. **Press Tab to move to the next line, if any.**

   Repeat the entry sequence of network number, zone name, and port description for each network connection.

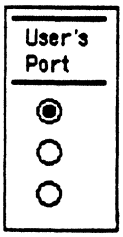
The User's Port

If the Macintosh used as a router is providing another network service concurrently, such as an AppleShare file server or print server, the User's Port must be selected to determine on which of the connected networks the server's name will be registered.

After you select one of the router's connected networks as the User's Port, any server operating on the router Macintosh will be registered on that network.

The User's Port is particularly important if the internet is divided into zones. When you select the User's Port, you also designate the zone to which the router node—and any network service on that node—will belong. The zone you designate for this node is the zone that network users will need to select in their workstation Chooser to be able to view and access the node's services.

Selecting a User's Port will not affect the router's operation in any other way. If the Macintosh is to be used as a dedicated router with no other services running concurrently, the User's Port may be ignored.



To select the User's Port:

- **In the User's Port column, click the button next to the appropriate port name to select a network.**

If the User's Port has only a single zone name, the task has been completed.

If there is more than one zone in the User's Port zone list, you will need to select one zone from this list as the "node's zone" to which the router Macintosh will belong.

You can select the router's zone only after the router has been made active for the first time. Instructions for selecting the zone follow the instructions for starting up the router, at the end of this chapter.

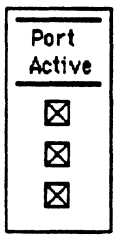
The first router port you set up automatically becomes the User's Port. If you delete the network assigned as the User's Port (by deleting its network number), the next available port in the Router Setup window becomes the User's Port.

Port status

The status of a router port is either *active* or *inactive*. Packets are routed only through active ports.

When you define a port's connected network, the router assumes this port will be active when you run the router, and sets the Port Active check box to On (an *X* appears in the check box).

If you wish to make any router ports inactive, you need to change the status setting for those ports.



- **To make a port inactive, click its Port Active check box to change the setting to Off.**

  The *X* is deleted from the check box.

You may not need to use this feature during the router's initial setup, but you may wish to deactivate ports in the future for testing or troubleshooting purposes. Changing the status of a port on an active router is described in the next chapter.

❖ *Note:* You cannot deactivate the User's Port. This would cut off access to any network services, such as a file server, running concurrently on the router Macintosh.

Entering a name for the router

The router must have a name to register on the network so that you can easily identify it on device listings during network maintenance and troubleshooting. (Until the router is named, the name "Unnamed" will appear in its displays.)

Use the following procedure to name the Macintosh router.

1. **Open the Chooser from the Apple menu.**

2. **Enter a name for the router in the User Name box at the lower right.**

3. **Close the Chooser.**

If the router was active when you entered the name, you'll have to restart the Macintosh before the name appears on the router's displays. If the router was inactive, the new name will appear in the title bar of all router displays beginning the next time you close and reopen the Router desk accessory.

If the user name you enter duplicates another router's name in its zone, a number will automatically be appended to each duplicate name (for example, RouterMac1, RouterMac2, and so on).

Starting the router

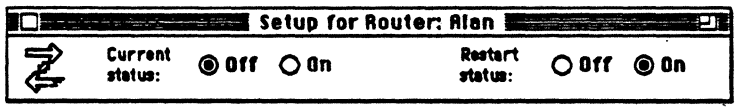
When you've completed router setup, you're ready to start up the router. Note that the router will not start operating until you restart the Macintosh computer.

△ **Important** If the router Macintosh is running any concurrent application, such as file server software, you'll need to perform an orderly shutdown of that application before restarting the system. △

Router status settings

Notice the router status settings at the top of the Router Setup window. When a setting is selected, the radio button next to it is filled in.

■ **Figure 6-3** The Setup window's router status settings



The options presented for router status settings are described in Table 6-2.

■ **Table 6-2** Router status settings

Current Status	
Off	Select this setting to make an active router inactive. This takes effect immediately, and cannot be reversed until the router is restarted.
On	This setting confirms that the router's status is currently active. When the router is inactive, this button is dimmed and cannot be used to turn the router back on. You must use the Restart Status button and restart the Macintosh to do this.
Restart Status	
Off	Select this setting if you do not wish the router to be activated at startup. This does not affect the router's current operation.
On	Select this setting to make the router automatically active whenever the Macintosh is started up.

- *Starting the Macintosh without the router:* When the router's Restart Status is set to On, you can still start up the Macintosh without loading the router. To do so, press and hold down Command-r (the Command key and the letter "r") while the System is loading. When the Macintosh starts up, the router's Current Status and Restart Status will be Off.
- *AppleTalk services on the Macintosh:* When the router is turned off, AppleTalk services will continue to be available to the router Macintosh through the network port designated as the User's Port.

Saving the router setup and restarting

Before starting the router, use the following procedure to save the setup information you've entered. You can then restart the Macintosh to turn the router on, or leave the router inactive until you're ready to use it.

1. **If you wish to make the router active at this time, make sure that Restart Status is set to On.**

   If you're not ready to start the router, leave the Restart Status Off.

2. **Close the Setup window.**

   A dialog box asks you whether you wish to save the changes made to the setup.

3. **Click the Yes button or press Return to save the setup information.**

   Your entries are saved in the Router file in your System Folder, and the Router desk accessory is closed.

4. **Choose Restart from the Special menu.**

   When the Macintosh restarts, if Restart Status was set to On, a dialog box notifies you that the router software is loading. If any error prevents the router from starting properly, you are notified by a dialog box, and you can return to the Router Setup window in the Router desk accessory to correct the problem (see Chapter 11, "Troubleshooting," for assistance if necessary).

△ **Important** When the router is inactive, it saves setup information on the current startup disk.

When the router is active, it saves setup information on the disk from which the router was started. The current startup disk may be a different disk if an application (such as the Installer program) caused the system to switch to another startup disk without restarting the Macintosh. This process is called *switch launching*.

Although you may rarely or never switch launch the router Macintosh to a new startup disk while the router is active, it's important to be aware that potential conflicts may result. △

Selecting a zone for the router

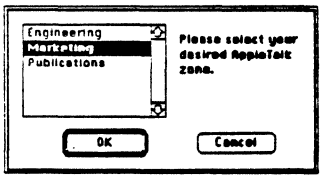
The zone list you have entered for the User's Port is the list of zones available for the router Macintosh. If you wish the router Macintosh to belong to the *default zone* in that list, no further selection is needed. To select a different zone for the router, use the following procedure:

1. **Open the Control Panel and click the Network icon .**

2. **Click the icon for the AppleTalk network type connected to the User's Port.**

   The zone list for this network is displayed.

3. **Select the desired zone for the router from the zone list and press Return.**



4. **Close the Control Panel.**

   The Macintosh and any server running on it now belong to the selected zone.

CHAPTER 7

Making Changes in the Router's Setup

THIS CHAPTER DESCRIBES HOW YOU CAN MAKE CHANGES TO THE NETWORK identification information entered in the Router Setup window.

You can view the information and settings in the Router Setup window at any time by choosing Router Setup from the Router menu. However, most of this information can be changed only while the router is turned off.

Making changes while the router is running

Since an active router is moving "live" network traffic around the internet, most changes in its setup cannot be made while it is running. The AppleTalk Internet Router limits setup changes you can make on an active router to changing the active/inactive status of router ports, and the on/off settings of the router itself.

Changing port status

While the router is active, you can inactivate any network port except the port of the User's Network (this port must remain active for AppleTalk services on the router's Macintosh).

You can also activate an inactive port while the router is running.

1. **To change port status, click the check box in the Port Active column next to the desired port name.**

   If you are making an active port inactive, a dialog box asks you to confirm your command.

2. **Click OK to confirm the change.**

   The change in port status takes place *immediately*; there is no need to restart the router or close the Router desk accessory.

△ **Important** Making an active port inactive may cause users on connected networks to lose access to network services. Be sure to give adequate warning to users who may be affected by the change in the router's setup. △

Changing router status

While the router is active, you can use the Current Status and Restart Status radio buttons in the Router Setup window to turn the router off or to change the router's on/off status on restart. These changes are described in "Router Status Settings" in Chapter 6.

Unlike other changes to the router's setup, changes to router status are saved in the Macintosh computer's *parameter RAM* (nonvolatile memory), not in the Router file.

Making changes while the router is off

While the router is turned off, you can make changes to any selection or information that you enter during router setup. These changes are saved in the Router file on the current startup disk when you close the Rou;r desk accessory.

Apart from changes to port status and router status, described above, changes to the router setup can be made only while the router is inactive.

Changing the User's Port

Click the User's Port button next to the name of the port you want to select. Only one port at a time can be selected as the User's Port.

When you select the User's Port , you also designate the zone in which the router will reside. This will affect the way network users can access any server running concurrently on the router Macintosh.

If the new User's Port you select has a zone list, the router Macintosh will belong to the default zone in this list. If you wish to select a zone *other* than the default zone for the router, refer to "Selecting a Zone for the Router," in Chapter 6.

Adding or deleting a port

The procedure for adding a network port to the router setup is identical to the procedure defining a port in the original router setup, described in Chapter 6.

The procedure for deleting a network port is as follows:

- **If the connected network is identified by a network number, delete the network number.**
- **If the connected network is identified by a network range, delete the first number in the range.**

Changing port status

The procedure for changing a port's status on an inactive router is identical to the procedure for changing port status on an active router, described earlier in this chapter.

Changing the network number or range

To change a network number or range:

1. **Select the current number by clicking the entry.**
2. **Type the new number.**
3. **Press Tab to advance to the next field.**
4. **If you are changing a network range, repeat steps 1 and 2 in the second entry field.**

△ **Important** Once a network number or range has been used on an active router and has become part of the internet, it should not be changed unless necessary.

Changing the number or range of a network can cause errors in internet routing to and from nodes in that network. This is because when a node is started up, it acquires its network address from the router and saves it in memory. The node becomes aware of any change in its network number only when it is restarted. Until the node is restarted, information destined for that node and information the node sends out will bear an incorrect network address. △

Changing a network's zone name or zone list

The zone names you specify in the router's Setup window also appear in the routing tables of all other routers on the internet and in the Chooser of each workstation on the internet. They're also used in network administration utilities and network maps used for troubleshooting.

Since changing a zone's name will have such widespread effects, it's important to notify users of the network system about the change. The procedure will require the router to be shut down for a period of time, so it's best to perform it at a time of low network use.

▲ Warning To avoid conflicts when you change a network's zone name or zone list, you must shut down all routers connected to the network and make the identical name changes in each seed router for that network.

Before restarting the routers, wait *at least* 10 minutes since the routers were originally shut down. This delay will "age out" the old zone name from other routers on the internet. When you restart the routers in which the change was made, the new name is acquired by all routers in the internet. ▲

Note that during the change process, a network whose zone name or zone list is being changed will neither have access to services on other networks, nor allow other networks access to its own services. However, services *within* the network will continue to operate.

To change a zone name:

1. **If the router is active, first give users adequate warning.**

   The AppleTalk Internet Router does not send any shutdown warning to user workstations. Be sure to inform users that this process will disrupt network services.

2. **Set router status to Off in the Setup window.**

   A dialog box asks you to confirm this selection.

3. **Shut down all other routers directly connected to the network whose zone list is being changed.**

4. **To change a name in a zone list, click in the Zone Name column next to the Network Range to display the Zone List dialog box.**

   - To delete a name in the list, click the name to select it, then click Delete.
   - To delete all names in the list, click Clear All.
   - To add a name to the list, enter the new name, then click Add.
   - To designate a new default zone, click the zone to select it, then click Set Default.
   - Click Cancel to close the Zone List dialog box without saving changes.
   - Click Done when the changes are completed.

5. **Close the Router desk accessory to save changes.**

6. **Repeat the above procedure for *all seed routers* directly connected to the network whose zone list is being changed.**

   Be sure to type exactly the same zone names in each router. The order in which you enter names in a zone list, need not match. However, all must indicate the same default zone.

7. **Be sure the affected routers have been turned off for *at least* 10 minutes before restarting them.**

8. **Restart all routers in which zone names were changed.**

Once all routers have been restarted, the zone name change has been completed.

△ **Important** If you're changing a zone name to an already existing name (that is, merging the zone into an already existing zone), be sure that no network services of the same type in these zones have the same name. (For example, two LaserWriters named "Sushi" would cause a conflict once they became part of the same zone; a printer and a file server having the same name would not.) △

Changing a port description

The port description you enter during router setup can be changed when the router is inactive. The port description is for your benefit and does not affect router functions in any way.

- **Select the current port description by dragging across the entry, type the new description in its place, and press Tab or Return.**

Changing router status

You can use the radio buttons in the Setup window to change the router's restart status, as described in "Router Status Settings" in Chapter 6.

You *cannot* change the router's current status from Off to On without restarting the Macintosh.

CHAPTER 8

The Network Information Window

THE APPLETALK INTERNET ROUTER'S NETWORK INFORMATION WINDOW displays a description of your internet that is useful in network administration.

This information includes

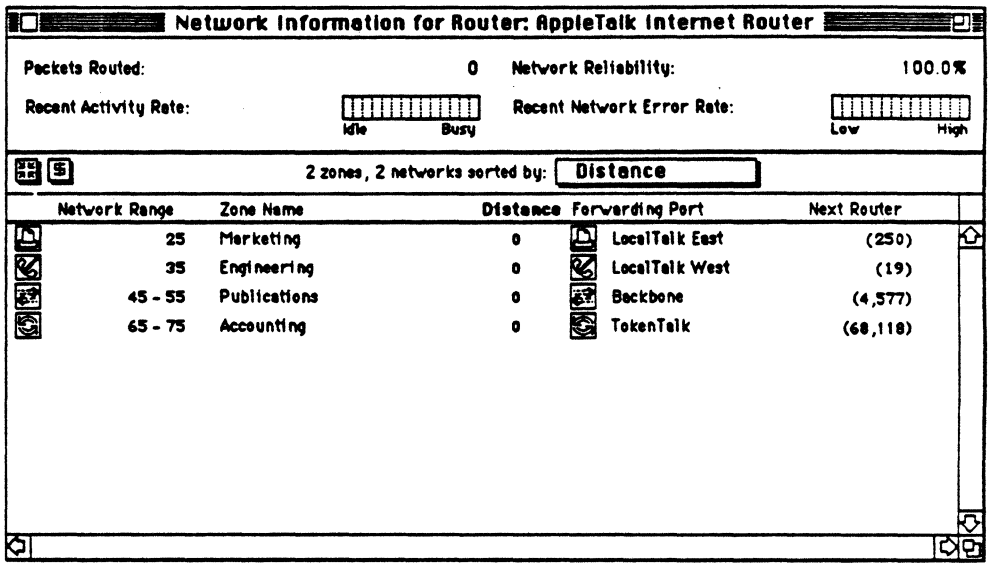
- general indicators of router activity levels
- a complete table of the networks in the internet, with routing information about each network

More explicit records of internet activity are provided in the Port Statistics window, described in chapter 9, "The Port Statistics Window."

The Network Information window is shown in Figure 8-1. This window is displayed the first time you open the Router desk accessory while the router is running, and can be accessed whenever the router is running by choosing Network Information from the Router menu.

You cannot display the Network Information window when the router is turned off.

■ **Figure 8-1** The Network Information window



Router activity readings

The upper portion of the Network Information window contains indicators of network activity and reliability levels. Their significance is summarized in the following sections.

- *Note:* The number of packets routed accrues continuously from the time of router startup until reset to zero by the Reset All Statistics command in the Router menu. This command is described in Chapter 10, "Router Administration."

Packets Routed

The Packets Routed listing represents the current total of packets that have been received and forwarded by the router since the time of the last reset.

This figure is an indicator of the router's overall usage. It can be helpful in monitoring and balancing the traffic among various routers in your internet, and as a general gauge of router activity.

This total includes only routed network traffic; it does *not* include

- packets from the User's Port related to nonrouter activity on the Macintosh, such as a concurrently running file server
- packets generated by network control software observing AppleTalk router maintenance protocols

Recent Activity Rate

The router's Recent Activity Rate meter shows the current level of traffic moving through the router.

This meter measures the activity rate continuously over a 2-second period and displays the level on a scale of 0–200 packets per second.

Network Reliability

The Network Reliability level is the percentage of total packets that are routed without error.

This reading represents the inverse of the percentage of network traffic recorded as errors, which includes errors listed in the router's Port Statistics window.

Recent Network Error Rate

The router's error rate meter shows the curent level of errors as a proportion of total router traffic.

This error rate displayed ranges from 0% to 10%, measured over a period of 5 seconds.

The routing table

The lower portion of the Network Information window contains the complete routing table of the internet.

For each network in the internet, the routing table lists:

- the network number or network range
- all zone names assigned to the network
- the distance in hops to the network from the current router
- the port through which to forward a packet to this destination
- the node address of the next router in the route

The AppleTalk Routing Table Maintenance Protocol (RTMP) keeps this table up to date through the regular exchange of routing tables among routers, causing each router to update its own table each time a new table is received, to reflect such changes as added and deleted networks.

The sections below describe the table's display settings and the significance of the table's components.

Selecting the display style

The Network Information window can be set to two display styles:

- The **summary view** display style lists only one single entry for each network in the internet.

- The **detail view** display style lists multiple entries for networks with multiple zones. A separate listing for the network is displayed for each of the network's zones.

The first icon in the left-hand portion of the routing table display allows you to switch between display styles.

To select the display style:

- **Click the display style icon to switch from summary view to detail view. Click it again to revert to summary view.**

◆ *Note:* When the display style is set to summary view, any network having more than one zone will display only the first alphabetical entry in its zone list. This zone name is followed by an ellipsis (...) to indicate that other zones are present.

Selecting the numeric display format

The Network Information window can be set to display numeric information in two formats :

- The **decimal** setting displays network and node numbers in decimal format.
- The **hex** setting displays network and node numbers in hexadecimal format.

The second icon in the left-hand portion of the routing table display allows you to switch between these two display formats.

To select the numeric format:

- **Click the numeric format icon to switch from decimal to hex. Click it again to revert to decimal format.**

◆ *Note:* When the numeric format is set to hex, all numeric listings are preceded by a dollar sign ($), and must be entered in this way as well.

Selecting the sorting order of the routing table

Directly above the routing table listing is a one-line display that summarizes the number of zones and networks in the table. This display also indicates the key item by which the table is currently sorted. The sort selection *pop-up menu* above the routing table allows you to select the sort key by which the information will be displayed.

For example, you may prefer to list networks by their distance from the router in hops, placing all the directly connected networks (0 hops) at the top of the list; or, if you employ a special network numbering scheme, you may wish to list networks by number.

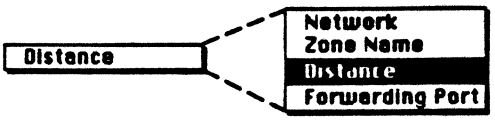
Figure 8-2 shows the sort order settings available.

To select the sorting order:

1. **Position the pointer inside the sort selection pop-up menu and press and hold down the mouse button.**

   The menu pops up, showing the sort order settings.

■ **Figure 8-2** The sort selection pop-up menu, closed and open



2. **Move the pointer up or down until it's positioned over the desired sort key, and release the button.**

   The routing table is reordered according to your selection, and the corresponding column heading in the routing table is in boldface.

   Another way to change the routing table's sort order is to click the heading of the column desired as the sort key. The display is immediately resorted using that heading as the key. (This applies to all except the Next Router column.)

Selecting the sort direction

The Network Information window normally displays the routing table sorted by the key you've selected, in *ascending* order—from A to Z, or from smallest to largest value.

To change the sort direction of the routing table to *descending* order:

■ **Hold down the Option key while clicking the heading of the column serving as the sort key (this heading is in bolder type).**

The sort direction of the routing table is immediately reversed.

Another way to change the routing table's sort direction is through the Settings dialog box, which is described in Chapter 10, "Router Administration."

The routing table display

The routing table is a dynamic display that reflects continuous changes in routing information on the internet.

The larger the internet, the more likely it is to be undergoing change, as routers update one another about alternate routes, distances, and changes in network connections.

Table 8-1 describes ways to control the routing table display as you view it.

◆ *Note:* Whenever a change is made to an entry in the routing table, that item is boldfaced for a few seconds to call your attention to the change.

■ **Table 8-1** Routing table viewing options

Action	Result
Hold down the Command key while viewing the routing table.	The routing table display is "frozen" so that no changes are shown until the Command key is released. You can still scroll through the list.
Click a column heading.	The routing table is resorted with that column as the sort key.
Hold down the Option key while clicking a column heading.	The order of the selected column is changed from ascending to descending, or vice versa.

Routing information

The following sections describe the individual columns displayed in the routing table.

Network Range

The Network Range column lists the network number or range of each listed network. The listing is displayed in decimal or hexadecimal notation, depending on which numeric format you have selected.

To the left of the network's number is an icon representing the router port to which the network is connected, if it is a directly connected network.

Remember that directly connected networks for which this router is not a seed router will not be displayed in the routing table until their network numbers are acquired from their seed routers.

Zone Name

The Zone Name column lists the zone name(s) associated with the network listed on this line.

When the display is set to summary view, any network having more than one zone will display only the first alphabetical entry in its zone list. This zone name is followed by an ellipsis (...) to indicate that other zones are present.

Distance

The Distance column shows the distance, in hops, from this router to the network listed on this line.

The distance to any given network should in general not change unless a new router is introduced. However, if a network becomes unreachable, its distance may change to 15 and be removed from the table.

A distance of zero is listed for networks that are directly connected to this router.

Forwarding Port

The Forwarding Port column shows the Macintosh port through which this router will *forward* a packet in order to reach the destination network listed on this line. This is illustrated in Figure 8-3.

The Forwarding Port's name is acquired from the Port Description field of the Router Setup window; the icon for the port's network driver is also displayed.

Next Router

The Next Router column lists the node address of the next router in the route to the destination network listed on this line.

The Next Router is located on the network connected to the *forwarding port* for the destination network. This is illustrated in Figure 8-3.

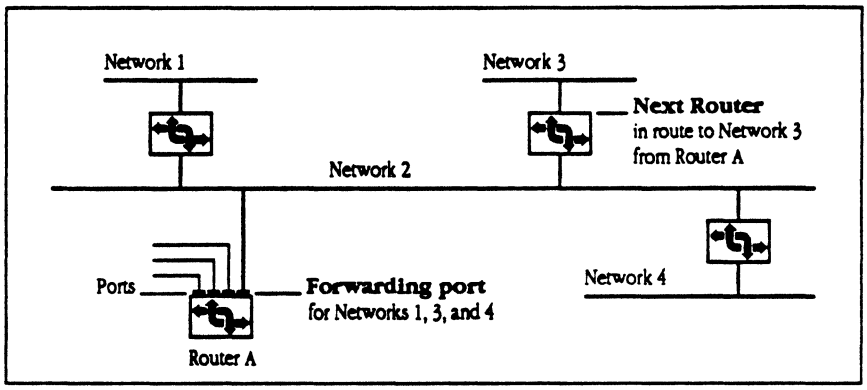
The Next Router address is displayed in two ways:

- If the router is on a LocalTalk network, this address is listed as the router's node ID number.
- On networks having a network range, the Next Router's address is listed as the router's node address (the network number within this range, followed by the router's node ID number).

For a network directly connected to the router, the address listed as the Next Router is the router's *own* node address on this network. This address is shown in parentheses.

- *Note:* Since a node's number need be unique only on its *own* network, duplicate node numbers may appear for routers on different networks.

■ **Figure 8-3** The Forwarding Port and Next Router in an internet route



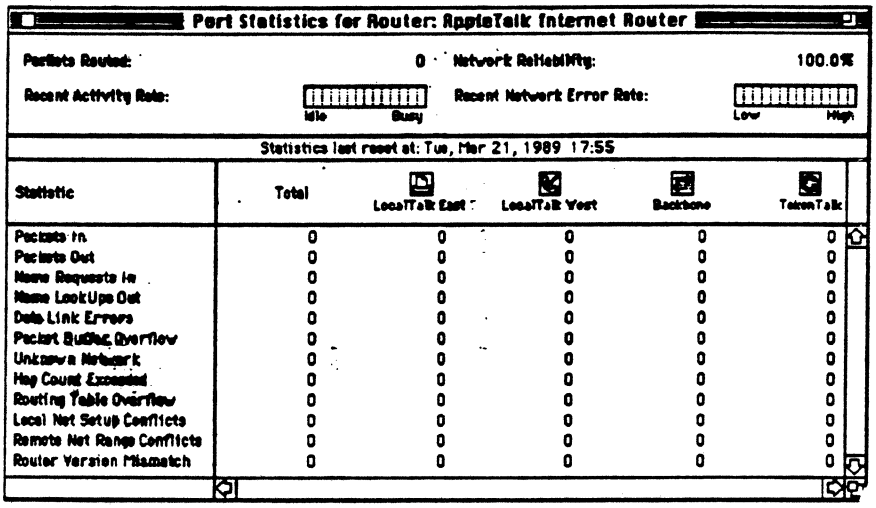
CHAPTER 9

The Port Statistics Window

THE APPLETALK INTERNET ROUTER'S PORT STATISTICS WINDOW DISPLAYS continually updated totals for a variety of significant traffic events and errors, listed separately for each of the router's connected networks.

At any time while the router is running, you can display the Port Statistics window shown in Figure 9-1. To do so, choose Port Statistics from the Router menu.

■ **Figure 9-1** The Port Statistics window



Interpreting network statistics

The router's statistical figures may not have immediate significance to you. As you monitor router activity over time, you will become familiar with normal levels of activity and errors, and learn to interpret deviations.

Since statistics are listed separately for each port, you can use this display to compare traffic and reliability levels of connected networks. When comparing network statistics, be sure to compare networks of the same type: LocalTalk only with other LocalTalk networks, and so on.

If, for example, you find one of the networks running particularly high levels of traffic and errors, this might suggest a problem with the distribution of services or users among connected networks (assuming you've ruled out a hardware malfunction). You can try to correct this problem by relocating servers, printers, or workstations, restructuring the affected networks, or adding a backbone network.

Router activity readings

The upper portion of the Port Statistics window contains the general router activity readings. These readings are the same indicators displayed in the Network Information window:

- Packets Routed
- Recent Activity Rate
- Network Reliability
- Recent Network Error Rate

Refer to Chapter 8, "The Network Information Window," for a detailed description of these readings.

Below the router activity readings, a one-line listing indicates the time and date at which the port statistics were last reset. The statistics listed below represent routing activity and errors incremented since that time.

Statistical listings

The Port Statistics window contains three basic classifications of statistics:

Operational statistics:	Packets In Packets Out Name Requests In Name LookUps Out
Network activity errors:	Data Link Errors Packet Buffer Overflow Unknown Network Hop Count Exceeded
Router setup errors:	Routing Table Overflow Local Network Setup Conflicts Remote Network Range Conflicts Router Version Mismatch

All statistics are listed in two ways:

- collectively for the router (Total)
- individually by network port

The listed totals are continually incremented from the time the router is first started until it is shut down, or until the statistics are reset. When a port is made inactive and later reactivated, the count is not reset to zero but simply continues to increment.

Statistical values for currently inactive ports are displayed in italics.

The sections that follow describe each of the statistical listings and their potential significance.

Packets In

The Packets In value shows the total number of data packets *intended for routing* received by the AppleTalk Internet Router. Packets pertaining to router maintenance and nonrouting services on the Macintosh (such as file server activity) are not included.

Packets Out

The Packets Out value shows the number of data packets routed by the AppleTalk Internet Router. Packets pertaining to router maintenance and nonrouting services on the Macintosh (such as file server activity) are not included.

△ **Important** The total numbers of packets in and packets out will not necessarily be equal, since these values will reflect errors that occur while forwarding. △

Name Requests In

Name Requests In are requests for network device names transmitted during network activities, such as listings by workstation Choosers and network searches performed by network management software.

If statistical totals indicate an unusually high number of Name Requests through a given port, a problem may exist on the network connected to that port. For example, if a user left an unattended workstation with its Chooser window opened and with LaserWriter or AppleShare selected, Name Request traffic would be increased unnecessarily on that nework.

Name LookUps Out

Name LookUps are issued by the router in response to incoming name requests. A Name LookUp is used to acquire device names for listings in the Chooser or in network management displays.

When the router receives a Name Request, it creates a Name LookUp for each network whose zone list contains the zone named by the request.

The ratio of Name LookUps to Name Requests is determined by the number of times the zone name appears in zone lists for different networks. The greater the number of network zone lists in which a zone name appears, the higher the name lookup traffic that will be generated by a name request for that zone.

Data Link Errors

The Data-Link Errors value represents low-level, hardware-based errors occurring in the transmission of packets to and from the router.

The router is *not* capable of detecting such errors occurring on a network at large, between two remote devices; it can detect errors only in packets that it receives and transmits. An example of a possible data link error might be a packet corrupted by an improperly terminated network.

Packet Buffer Overflow

The Packet Buffer Overflow statistic shows the number of packets being discarded by the router as a result of an inflow rate that is higher than the outflow.

When the rate of incoming packets is higher than the outgoing rate, the overflow is handled by the router's buffer. Once this buffer becomes filled, packets are discarded until the imbalance is corrected.

Under normal usage conditions, no significant packet loss should occur. If this statistic is consistently high, the distribution of servers or other resources on connected networks may be unbalanced and require correction.

Unknown Network

A Unknown Network error is reported when the router has been requested to route a packet to a network not listed in its routing table.

Possible causes for this error include a break on the network system, caused by disconnected cables or other hardware malfunctions or by a problem with one of the other routers on the internet.

Hop Count Exceeded

The Hop Count Exceeded value indicates the number of packets that the router did not forward because the packets had already traveled 15 hops in one single route—the maximum allowed by AppleTalk protocols.

If this condition results from inefficient network layout, router placement in the internet should be redesigned so that no route exceeds 15 hops.

The Hop Count Exceeded error can also result from a packet entering into a temporary loop between routers. This can happen if a network in the internet becomes inaccessible and disappears from one of these routers' routing tables. Such a situation is corrected automatically by the continuous updating of routing tables, which quickly stabilize following any such conflict.

Routing Table Overflow

A Routing Table Overflow error is reported if more network segments are connected to the internet than can be stored in the router's routing table.

The routing table's maximum capacity is 1024 entries for network numbers *or* ranges. A network range counts as a single network entry in the table, regardless of how many network addresses are contained in the range.

Local Network Setup Conflict

A Local Network Setup Conflict error is reported if another router on a network that is directly connected to this router lists a conflicting network number or range for that network.

Although this conflict will not normally occur on the AppleTalk Internet Router (the router will not start up if it detects this situation), a router from another manufacturer lacking this safeguard may be connected to your network, or a router may have been connected to the internet after it was turned on.

Remote Network Range Conflict

A Remote Network Range Conflict error is reported if another router lists a network range in its routing table that conflicts with the current router's routing table.

For example, one router could list a network range of 3–57 for a connected network, and another router could list a range of 4–60 for a different network. Such overlapping network ranges are not permitted in an internet.

Router Version Mismatch

A Router Version Mismatch is reported each time a routing packet is received from a router on the internet that does not support AppleTalk Phase 2.

Resetting the statistics

The AppleTalk Internet Router's statistical display will continue to increment the totals for each value until the display is reset or the router is shut down. When reset or restarted, the values will begin to increment from zero once more. (The Packets Routed reading in the Network Information window is reset as well as all port statistics.)

For any individual value, the displayable limit is 99,999,999, after which the value will cease to increment until reset.

To reset statistics:

1. **Choose Reset All Statistics from the Router menu.**

   A dialog box asks you to confirm your selection.

2. **Click OK.**

   The statistical and activity values are set to zero, the activity level meters are restarted, and the time of reset is displayed in the Port Statistics window.

CHAPTER 10

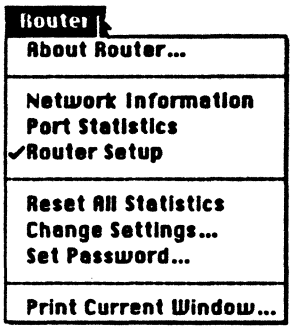
Router Administration

THIS CHAPTER DESCRIBES THE ADMINISTRATIVE FUNCTIONS PRESENTED IN THE Router menu:

- Reset All Statistics
- Change Settings
- Set Password
- Print Current Window

Router administration functions are accessed through the Router menu, shown in Figure 10-1.

■ **Figure 10-1** The Router menu



Reset All Statistics

The Reset All Statistics command resets

- the time of last reset shown in the Port Statistics window
- the statistical listings in the Port Statistics window
- the activity readings that appear in both the Port Statistics and Network Information windows

These statistical and activity values accrue continually from the time that the router is started until they are reset.

To reset statistics:

1. **Choose Reset All Statistics from the Router menu.**

   A dialog box asks you to confirm your selection.

2. **Click OK.**

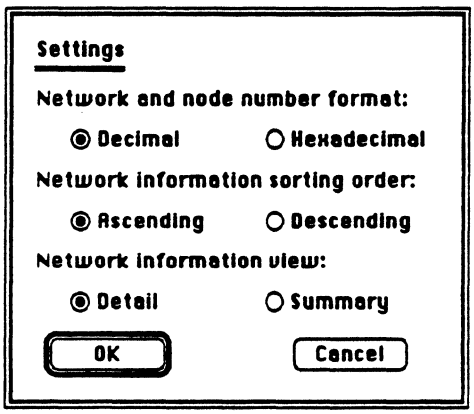
   The statistical and activity values are set to zero, and the activity level meters are restarted.

Change Settings

When you choose the Change Settings command from the Router menu, the Settings dialog box shown in Figure 10-2 is displayed.

◆ *Note:* The router setting options are also described in chapters covering the individual displays affected by these settings.

■ **Figure 10-2** The Settings dialog box



To change any setting, click the radio button next to the option you wish to set. The router setting options are described in the following sections.

Network and node number format

This setting controls the display of network numbers and router addresses (node numbers) in the router's Setup and Network Information windows.

Decimal

Network and node numbers will be displayed in decimal notation.

Hexadecimal

Network and node numbers will be displayed in hexadecimal notation (base 16). Hexadecimal numbers are displayed preceded by a dollar sign ($) and must also be entered in this format.

Network information sorting order

The networks listed in the Network Information window's routing table will be sorted using the key selected in that window's pop-up menu. The choice of ascending or descending order can be set in the Settings dialog box.

Ascending

The routing table will be sorted with entries listed in ascending order.

Descending

The routing table will be sorted with entries listed in descending order.

Network information view

This setting selects the level of detail displayed in the Network Information window's routing table. The changes in the way network listings are displayed apply to networks with multiple zones only. LocalTalk networks are unaffected.

Summary view

The summary view lists only one entry for each network in the routing table.

- *Note:* When the display style is set to summary view, any network having more than one zone will display only the first zone name in its zone list. This zone name is followed by an ellipsis (...) to indicate that other zones are present.

Detail view

The detail view lists multiple entries for networks having multiple zones. A separate listing for the network is displayed for each of the network's zones.

Set Password

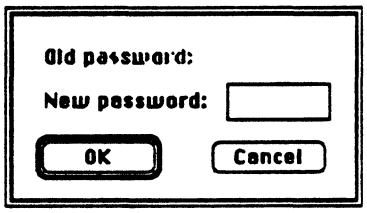
If you wish, you can restrict access to the AppleTalk Internet Router through password protection, so that no unauthorized users can change the router's setup or status settings.

To set password protection:

1. **Choose Set Password from the Router menu.**

   The Set Password dialog box shown in Figure 10-3 is displayed.

■ **Figure 10-3** The Set Password dialog box



2. **Type any password you like, using up to 8 characters.**

   The characters you type are displayed as bullets to prevent the password from being visible to others.

3. **Press Return or click OK.**

   You're asked to reenter the password for confirmation.

4. **Retype your password.**

   Type each character exactly as before. The router distinguishes between uppercase and lowercase characters in passwords.

5. **Press Return or click OK.**

Password protection is now activated. Anyone who tries to open the Router desk accessory when the router is inactive will be asked to enter the password first.

You will also need the password to access the Router Setup window while the router is active. You may then leave the Router Setup window and will not need the password to return to it until the Router desk accessory is closed.

△ **Important** To prevent unauthorized access, always be sure to close the Router desk accessory after using the Setup window. △

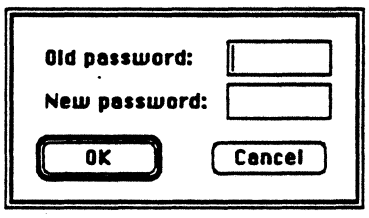
Changing your password

To change a password:

1. **Choose Set Password from the Router menu.**

   The Change Password dialog box shown in Figure 10-4 is displayed.

■ **Figure 10-4** The Change Password dialog box



2. **Type your old password, but do not press Return.**

3. **Press Tab, *not* Return.**

   Since the OK button is highlighted, pressing Return at this point has the same effect as clicking OK. But since the New Password box is blank, OK would confirm the blank passwork as your new password. Instead, press the Tab key to advance to the next box, or click in that box.

4. **Type your new password and press Return.**

   You're asked to reenter the new password for confirmation.

5. **Retype your new password.**

   Type each character exactly as before. The router distinguishes between uppercase and lowercase characters in passwords.

6. **Press Return or click OK.**

   Your new password is now set.

Canceling password protection

Repeat the procedure for changing your password, but do not enter any characters in the New Password box or the confirmation box.

1. **Type your old password.**

2. **Press Return or click OK.**

   You're asked to reenter the blank password for confirmation.

3. **Press Return or click OK once more.**

   Password protection is now canceled.

▲ Warning Keep a written record of the password you select in a secure place. If you ever lose or forget your password, you'll need to remove and reinstall the router software, and then reenter all the setup information. ▲

Print Current Window

The Router menu's Print Current Window command allows you to print each of the program's main display windows.

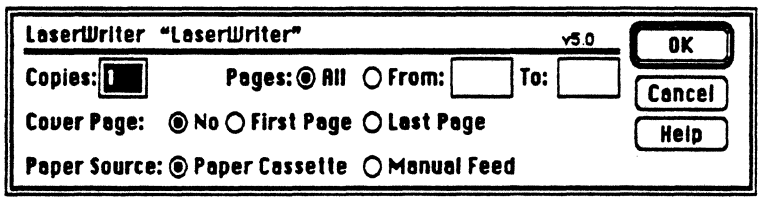
When you choose the Print Current Window command, the router's printing function is set to print the contents of the currently displayed window. If you wish to print a report for a different window, you'll first have to display that window.

To print out any of the router's displays:

1. **Make sure the desired printer is selected in the Chooser.**
2. **Choose Print Current Window from the Router menu.**

   The Macintosh Print dialog box shown in Figure 10-5 is displayed.

■ **Figure 10-5** The Print dialog box for a LaserWriter



3. **Select the desired printing options in the dialog box.**
4. **Click OK.**

   The contents of the current display are sent to the selected printer.

- *Printing to an AppleShare print server:* You *cannot* use the router's printing function to print to a print server residing on the same Macintosh as the router.
- *Printing on a floppy-only system:* Printer drivers are not provided on the AppleTalk Internet Router disk. If the router is running from this disk, you'll need to install printer drivers onto the System Folder of the disk.

CHAPTER 11

Troubleshooting

THE APPLETALK INTERNET ROUTER SOFTWARE IS DESIGNED TO SAFEGUARD against user errors occurring during router setup, such as invalid entries, and errors occurring during router operation, such as conflicting network numbers. Messages alert you of potential problems whenever possible.

However, while installing and operating the router, you may encounter problems that require you to take some corrective action. This chapter describes potential problems and remedies, and explains the router's significant error messages.

Problems with your network system

A network system can experience a variety of problems that affect the operation of your router. The symptoms may become known to you through the router's displays—for example, loss of communication through one of its network connections—but may in fact originate as a problem on the network.

It's important to distinguish between problems caused by your network system and those affecting only the router.

Recognizing network-related problems

You may encounter the following types of problems arising from the router's network environment:

- problems with physical network connections to the router
  - cables and connectors
  - network interface cards
- breaks in the network cable system caused by damage or accidental disconnection
- intermittent, temporary loss of a network connection caused by improperly connected cables
- network malfunctions caused by improper network layout or improperly terminated cables
- malfunctioning network devices
- incorrect software configurations (wrong versions of the System or Finder, or EtherTalk or LaserWriter drivers)

Most frequently, network problems will be caused by a physical break, or disconnection, in the network system. Should your router experience unexplained disturbances, make sure all physical connections are intact before assuming a router malfunction.

Common network-related problems

The troubleshooting scenarios below represent some of the most common internet problems encountered when routers are in use.

Before performing any of the troubleshooting operations described, make sure you've attempted to eliminate all possibilities that network hardware, cables, or connections are at fault.

Symptoms described below, such as devices missing from network listings, can be identical whether they are caused by a router setup error or by a disconnected cable.

■ Symptom **A zone name or network device is missing from the Chooser listings on one or more network workstations.**

Cause Two or more networks may have been assigned the same number, or overlapping network ranges, during their seed routers' setup. In this case, only the first of the conflicting networks encountered during a Chooser's device search will be recognized (generally the one closest—having the fewest hops—to the workstation performing the Chooser listing).

Solution You need to assign a new network number or range to one of the two networks.

It isn't necessary to locate both of the sources of conflict if you already know one of the networks involved (if a device is missing from node listings, it's the network on which that device resides). Simply assign a new number or range to the conflicting network that is known.

Refer to Chapter 7 for instructions on changing a network number.

- *Not all conflicts are detected:* The AppleTalk Internet Router cannot prevent the same number or range from being assigned to networks on different parts of the internet. The router can alert you of network number and range conflicts only when they occur during router setup, or when conflicting numbers are assigned to the *same* network by different routers.

To avoid assigning duplicate network numbers as you set up new networks and routers, always maintain an accurate and complete map of all networks in your internet.

- **Symptom** **One or more devices are listed in the wrong zone in the Chooser of a network workstation.**

  Cause 1 An AppleTalk zone name has been changed in a router that was then restarted earlier than the recommended delay period (see "Changing a Network's Zone Name or Zone List" in Chapter 7). As a result, there is a conflict between zones visible to users on the network whose zone name was changed and zones visible to other users.

  Alternatively, while a zone name was changed somewhere on the internet, a router may have been off or disconnected from the network, and then later restarted or reconnected.

  Solution 1 Shut down all the routers connected to the network in which the original change was made for at least 10 minutes, to allow other routers to "age out" any record of the conflicting zone name from their routing tables. This is done automatically as routers periodically update their routing tables, if they find that a network is no longer listed. Then restart all the affected routers.

  Cause 2 A router Macintosh that is concurrently used as a file server or print server has the wrong port selected as the User's Port in the router's setup.

  Solution 2 Shut down the router and change the User's Port.

- **Symptom** **A network is missing from the listing in the router's Network Information window.**

  Cause 1 No connected router was set up as a seed router for this network. All routers connected to it contain only the value zero in place of the network's number.

  Solution 1 Select a router connected to the missing network and use the router's Setup window to enter a network number and zone name, making this a seed router for the network.

  Cause 2 A router port to which the missing network is directly connected has been turned off. If more than one network is missing from the list, there may be an inactive port on a router somewhere in the path to these networks.

  Solution 2 Check the setup information in routers connected to the missing network(s) to make sure that all ports routing to the network(s) are active.

  Cause 3 The missing network is more than 15 hops away.

  Solution 3 Modify the placement of routers in the internet so that no route exceeds 15 hops.

Cause 4 The missing network is connected to a seed router that was very recently started up, and the router's setup information is not yet been acquired.

Solution 4 This condition should be self-corrected within a few seconds or minutes, depending on the size of your internet.

Cause 5 There are more than 1024 networks in the internet. (Few internets will exceed this limit.)

Solution 5 This can be corrected by using nonrouting bridge devices to combine groups of separate networks into larger networks, each having a single network address.

■ **Symptom** **Devices that should be in the same zone are not.**

Cause Zone names for one or more networks were entered incorrectly while setting up the router.

Solution Check seed routers for each network affected by this problem, to make sure that zone names were not mistyped when entered. The zone names must be typed identically for each network in order for devices in these networks to be part of the same zone (however, you need not match the case for uppercase or lowercase letters, and zone names need not be entered in the same order).

◆ *Note:* The Space character counts as a valid character in a zone name.

■ **Symptom** **Devices appear not to function, or a device that does function is not the one you thought you selected.**

Cause There may be more than one device with the name you selected. Duplicate device names are detected by AppleTalk protocols only at the time of device startup, so this problem might occur if a device was named *before* being connected to the network, or if zones containing devices with the same names were merged.

Solution In the zone where the problem occurred, check the names of all devices *of the same type* that is experiencing the problem, and rename any duplicates. Alternatively, you can restart all devices of the type experiencing the problem. Duplicate names will be automatically corrected at startup by AppleTalk software appending a number to the end of the name.

Where to find network troubleshooting information

As network systems grow larger and more complex, it becomes more difficult to locate the sources and causes of problems. A tool that can aid in network troubleshooting is the Inter•Poll network administrator's utility from Apple Computer, Inc.

Inter•Poll produces lists of all connected devices in a network, zone, or internet, to help you determine whether connection problems exist. Inter•Poll also reports on software version numbers in each connected workstation, to help you determine whether compatibility problems exist.

Inter•Poll can also perform loopback tests to individually targeted devices, to check the integrity of selected network paths.

Since routers are network devices, Inter•Poll reports all connected routers in its device listings and helps you to verify the status of multiple internet routers from one central location.

Contact your authorized Apple dealer for more information about Inter•Poll.

Problems with the AppleTalk Internet Router

Most types of router-related problems are detected by the AppleTalk Internet Router software and reported by error messages that alert you of the situation.

The error messages listed in this section are followed by a brief description of remedial action you can take.

When in doubt, or when faced with a problem that is not described in this chapter and does not respond to known remedies, a general measure *of last resort* is to remove and reinstall the router software. Before doing so, print out a record of the current router setup, if possible, to refer to when duplicating the setup in the new Router file.

Recognizing router-related problems

You may encounter the following types of problems arising from the router's own operating conditions:

- problems caused by constraints of the Macintosh computer, such as insufficient available memory
- problems arising during router installation, such as inability to locate needed resource files
- problems caused by changes made to the Macintosh router while it is active, such as a system disk being locked or becoming full
- problems caused by errors in setting up a router, as described below

In addition to the guidelines in this chapter, refer to Chapter 6, "Setting Up the AppleTalk Internet Router," to make sure you've explicitly followed the router setup instructions.

Errors in router setup

Most error conditions related to router setup are communicated to you through error messages. This section documents two problems that do not produce error messages. Additional error conditions are described in the message listings that follow this section.

- **Symptom** **The router Macintosh experiences a long delay during startup (up to several minutes).**

Cause An EtherTalk card installed in the Macintosh has an improperly terminated port or cable.

Solution Check the router's EtherTalk card(s). If no cable is connected to the port, a T-shaped *BNC* connector must be connected to the port and terminated with two Ethernet cable terminators. If a cable is connected to only one side of the connector, the other side must contain a terminator. Any cable(s) extending from the connector must also be properly terminated at both extremities.

If no terminators are missing from an EtherTalk connection, check for the possibility of a break somewhere along the Ethernet cable. The effects of improper termination can be produced by a break anywhere in the cable.

Once all connections have been checked, restart the router Macintosh.

■ **Symptom:** **The text in router windows is illegible or appears to be displayed in the wrong font.**

Cause The router Macintosh does not have the necessary fonts installed in its System Folder.

Solution The Router desk accessory uses the following fonts in its displays:

- 10-point Geneva
- 10-point Courier
- 12-point Chicago

If any of these fonts is not installed in the router Macintosh, use the Macintosh Font/DA Mover utility to add them to the System Folder. These fonts should be available on most Macintosh computers, but may have been removed from the Macintosh you are using.

Error messages at startup

This section lists error messages displayed during router startup. These messages indicate that some condition was encountered that prevents the router software from running.

When router startup is interrupted, the Macintosh reverts to using the built-in LocalTalk network connection (through the printer port).

△ **Important** After correcting a problem that has interrupted router startup, you need to reset the router's Restart Status to On in the Setup window before restarting the system. △

The Router could not run. A driver for one of the AppleTalk connections can not be found. The built-in LocalTalk port will be used for your AppleTalk connection.

No AppleTalk connection driver could be found for a port that you've set up. Check the System Folder and, if the required drivers are there, try to restart the router. If a driver is missing, or if the problem persists, reinstall the drivers and/or the router software.

The Router could not run because there is no seed router on the network connected to port [Port Description].

The Router could not run because there is no seed router on the network connected to the User's Port.

The Router could not run. An error occurred while installing a driver for one of the ports. The built-in LocalTalk port will be used for your AppleTalk connection.

The router software had a problem loading an AppleTalk driver. A possible cause is inability to find a network resource, such as an EtherTalk card. Make sure that no card has been moved since the router's setup. (This message will also appear if you've intentionally removed an interface card, until you change the router setup to reflect this change and restart.)

The Router could not run because AppleTalk services ould not be accessed.

Although AppleTalk may be active on your Macintosh, an external, network-based problem is making AppleTalk services inaccessible to you at this time. Possibly, all available node addresses on a connected network are being used.

The Router could not run. Please use the Chooser to activate AppleTalk.

Check in the Macintosh Chooser to make sure that AppleTalk is set to Active.

The Router could not run. Please use the Router DA to set up the Router's ports.

At least two ports must be set up before you can run the router.

The Router could not run. The Router file was not found. Please reinstall the Router.

Make sure the router file is in the System Folder. If it is there, try to restart the router. If it is missing, or if the problem persists, reinstall the router software.

The Router could not run. The startup disk is locked.

The startup disk on the router's Macintosh must be unlocked because setup information may have to be written to the disk. Unlock the disk, set Restart Status to On, and restart the router.

The Router could not run. The network number 111 you have set up for one of the Router's ports is in conflict with that network's actual number, 222. Please use the Router DA to correct that value.

A network number entered in this router's setup does not match that network's number as identified in a routing table received from another router on this network. Verify the information and correct it in the Router Setup window.

The Router could not run. The network range 110 to 111 you have set up for one of the Router's ports is in conflict with that network's actual range, 220 to 222. Please use the Router DA to correct that range.

A network range entered in this router's setup does not match that network's range as identified in a routing table received from another router on this network. Verify the information and correct it in the Router Setup window.

The Router could not run. The zone name 'xxxx' you have set up for one of the Router's ports is in conflict with zone name 'yyyy' on that port's network. Please use the Router DA to correct that zone name.

A zone name entered in this router's setup does not match that zone's name as identified in a routing table received from another router on this network. Verify the information and correct it in the zone list.

The Router could not run. The zone name 'xxxx' you have set up in the zone list for network range 111 to 222 is not in the actual zone list for that network. Please use the Router DA to correct that zone name.

A zone list entered in this router's setup does not match the zone list for this network range, as identified in a routing table received from another router on this network. Verify the information and correct it in the zone list.

The Router could not run. Zone name 'xxxx' has not been set up for network range 111 to 222, but is in the actual zone list for that network. Please use the Router DA to add that zone name.

A zone name in the zone list for the network range indicated appears in another router's routing table, but has been omitted from this router's setup. Verify the information and correct it in the zone list.

The Router could not run. The zone list you have set up for network range 111 to 222 is in conflict with that network's actual zone list. Please use the Router DA to correct that zone list.

The zone list you have entered for the network range indicated is entirely different from the zone list for this network range entered in another router. Verify the information and correct it in the zone list.

The Router could not run. The default zone 'xxxx' you have set up for one of the Router's ports is in conflict with default zone 'yyyy' on that port's network. Please use the Router DA to correct that default zone.

The default zone selected for a network range must be the same in each seed router for the network having that range. Verify the information and correct it in the zone list.

The Router could not run. The Router file is damaged. Please reinstall the Router.

Some portion of the router software has become corrupted. You must reinstall the router software.

Error messages in the Router desk accessory

Error messages listed below are displayed during during operation of the Router desk accessory. The messages are listed alphabetically and are followed by an explanation only if you need to respond in a way that isn't explained by the message text.

- *Audio or visual alert:* If, while trying to open the Router desk accessory, the system beeps once and returns to the Finder, system memory is insufficient to open the desk accessory. You may need to shut down any concurrent applications before opening this desk accessory. (If the volume has been set to zero on the Macintosh Control Panel, the menu bar will flash once.)

A network number can only have decimal or hexadecimal digits.

A network range must consist of two numbers. Both numbers must be zero or both numbers must be non-zero.

If you enter a zero to indicate a nonseed port, both numbers in the range must be zero. If this is not a nonseed port, neither number may be zero.

A network range must not duplicate or overlap another network range.

Two or more networks have been set up with the same network number. Each network on the internet must be given a unique number, unless it is the value zero.

A port description cannot be more than 31 characters in length.

At least one port must be set up if the Restart Status is set to On.

At least one zone name must be entered if the port's network number field is not zero.

If a nonzero network number is entered for a network during router setup, at least one zone name must be entered. A zone name must be entered even if the internet contains only one zone.

A User's Port must be selected.

The router cannot run unless one of the networks listed in the Setup window is selected as a User's Network. See the setup instructions in Chapter 4.

A zone name cannot be more than 32 characters in length.

A zone name of "*" is not allowed.

The single asterisk character is reserved by AppleTalk protocols to signify "this zone." It cannot be used as a zone name.

Confirmation of your new password has failed.

The password you typed does not match your first entry. Carefully retype your passwords, making sure to match uppercase and lowercase characters.

Could not find the Router file. Please reinstall the Router.

Could not open the Router file. Please reinstall the Router.

There may be too many files open on this Macintosh, or the Router file may be missing. Make sure the Router file is in the System Folder. If it is there, try to restart the router. If it is missing, or if the problem persists, reinstall the router software.

Could not save setup information in the Router file. Please check that the disk is not locked before continuing.

The startup disk on the router's Macintosh may be locked. It must be unlocked so that setup information may be saved. Unlock the disk and continue.

Network numbers must be in the range of 1-65279 ($1-$FEFF hex) for seed ports, or zero for non-seeed ports.

Printing could not be completed. The Router software was damaged or incorrectly installed. Please reinstall the Router.

This message is displayed if any error occurs while using the Router menu's Print Current Window command. Check that the printer is operating properly and try reprinting. If the problem persists, there may be insufficient memory to run the printing routines. Try selecting another printer in the Chooser.

The new password could not be saved. Please check that the disk is not locked before continuing.

The port cannot be activated. Conflicting information for this network was entered in another Router.

While the port was inactive, conflicting network number or zone name information about the connected network was entered in another router. Verify the information and change the router setup as needed.

The port description cannot be more than 31 characters long.

There is not enough memory to open all the AppleTalk connection files. Please close other applications or DAs before continuing.

There is not enough memory to open the Router DA. Please close other applications or DAs before continuing.

If one or more concurrent applications are running on the router's Macintosh, there may be insufficient available memory to run the Router desk accessory. You'll need to perform a shutdown of a concurrent application before running the router, and may need to install additional memory to run these concurrently.

There is not enough memory to print. Please close other applications or DAs before continuing.

There is not enough memory to save the setup information. Please close other applications or DAs before continuing.

The Router cannot print to a spooler installed on this machine. Please open the Chooser and select another printer.

The printing service currently selected in the router Macintosh Chooser is a print spooler, such as the AppleShare print server, that is running on the router Macintosh. You must select a different printer to print from the Router desk accessory.

The Router can not run on this model of the Macintosh computer.

The AppleTalk Internet Router can be run only on the Macintosh Plus, Macintosh SE family, and Macintosh II family computers.

The Router software was damaged or incorrectly installed. Please re-install the Router.

The router software will not be available if the Router file was incorrectly installed. You cannot use the Macintosh Font/DA Mover utility to install the Router desk accessory. Restart the router, and if the problem persists, reinstall the router software.

Too many characters have been entered.

You cannot set up the Router. No AppleTalk connection drivers were found in the System Folder. Please reinstall the Router.

AppleTalk connection drivers are needed for the router to recognize the different AppleTalk network connections. Restart the router from the disk onto which the router software was installed. If the problem persists, reinstall the drivers and/or the router software.

You cannot enter a zone name if the port's network number is set to zero.

You cannot make the User's Port inactive

Deactivating the User's Port is not permitted. This would cause network services on this port to be lost. Any concurrent application on the router's Macintosh, such as an AppleShare file server, could be lost to network users.

You cannot set up more than 8 ports.

Your password cannot be more than 8 characters long.

You typed the old password incorrectly.

You typed the password incorrectly.

Appendixes

A P P E N D I X A

Planning an AppleTalk Internet

THIS APPENDIX PROVIDES GUIDELINES FOR PLANNING

- the layout of an AppleTalk internet
- the placement of internet routers
- the assignment of network numbers, ranges, and zones

These guidelines are provided for network administrators at all levels of experience, but the information is particularly relevant to beginning network administrators. While the discussion of planning, in some cases, assumes you are creating a *new* internet, the guidelines apply equally to installing a router in an existing internet.

When do you need to create an internet?

Three situations most commonly call for installing a router to create an internet:

- **To connect two or more existing networks**

  Generally, computer networks that serve the needs of separate work groups in different parts of an organization are installed separately. Routers can connect these networks into an internet, allowing users on each network to access network services on the entire internet.

  These networks may be of different types, using different connection methods and transmission media, and may require a router that can overcome these differences while connecting the networks together.

- **To enlarge a network that has reached its maximum length or number of devices**

  A network can be enlarged beyond its specified limits by the addition of a router. Devices called *repeaters* and *bridges* also allow you to increase a network's size and number of devices, but they do not produce separate, individually addressable networks.

  Rather than adding cables and devices to a single network, it is often more efficient to grow by creating new networks, using routers. This can result in better performance on each new network, and allows the creation of independent work groups.

- **To isolate traffic on different parts of a network**

  When many users try to use network services simultaneously, network performance is reduced. For example, one group of network users performing frequent, high-volume printing tasks might cause network congestion for all other users.

  A router can separate such a network into two networks that can communicate with each other but that are functionally independent—thereby isolating local traffic on each network and improving performance.

These three objectives are not mutually exclusive; the creation of an internet often involves several routers and may satisfy all the above objectives.

Planning the physical layout of an internet

Since most computer networks are likely to grow, it's important to design an internet that will continue to deliver high performance as you connect new networks and add computers and servers.

The key to an expandable internet is a layout that supports growth while maintaining the most efficient route possible between any two networks—in terms of both hops (the number of intervening networks) and speed.

Creating a map

Begin the internet planning process by creating a map of the desired internet layout. This map can be hand drawn, or computer aided with the help of graphics software, such as MacDraw®.

It's useful to obtain floor plans of the building locations involved in the internet, to help determine the relative scale and locations of the networks you need to draw. (Floor plans may be available from the facilities management department of your company or the building management office of your building.)

Using a copy of the floor plan as a background, draw in the networks and routers needed for your internet. Use the guidelines for network layout provided in this appendix, and make adjustments to fit your plan as necessary.

The network map will serve three purposes:

- To help you determine where routers are needed
- To help you determine the optimum placement of routers for the least number of hops between all connected networks
- To provide a visual reference of where networks and devices are located, for use in troubleshooting network problems once the internet is operating

The network map will be equally useful whether you are laying out a new internet or installing routers to connect existing networks.

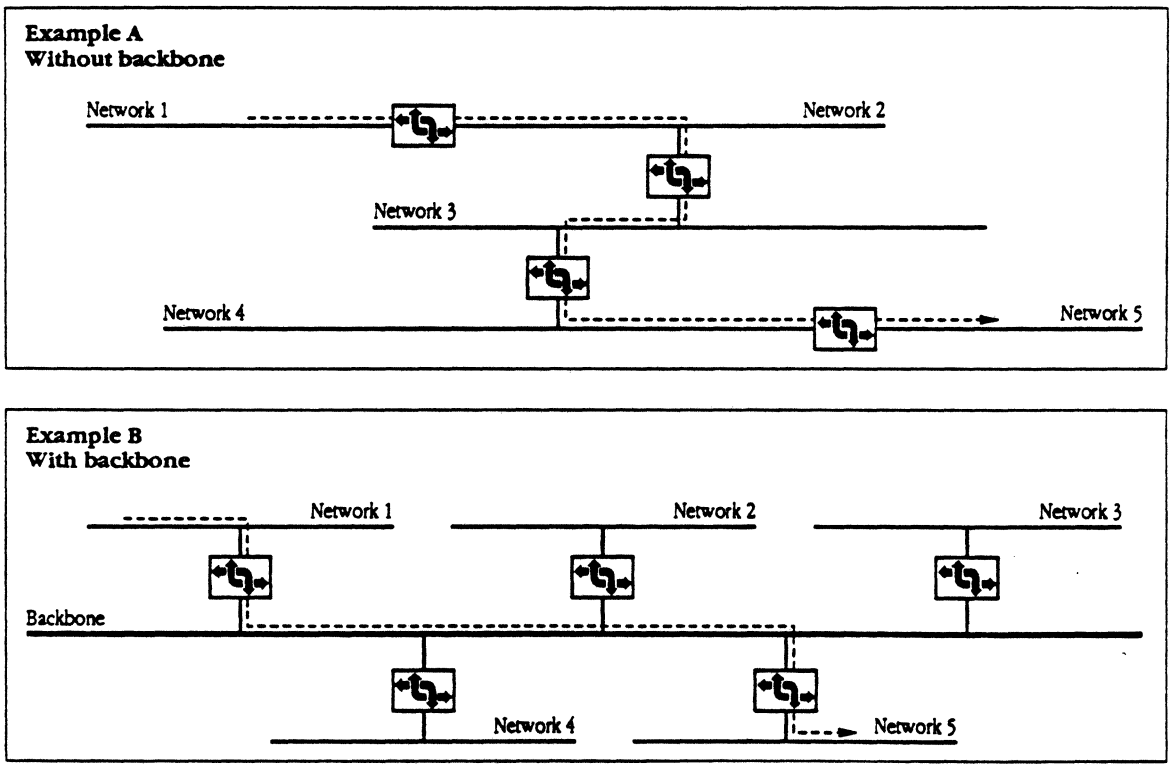
Backbone networks

As you develop an internet plan, you will find that the creation of backbone networks is one of the most useful tools available for designing an efficient internet layout.

A **backbone network** is a network whose primary function is to transport information between other networks, which are connected to the backbone by routers. In the design plan of an internet, a backbone can help to create efficient routes between all parts of the internet. Each network connected to a backbone is no more than two hops from any other network connected to the backbone. This is illustrated in Figure A-1.

It's advantageous to create a backbone network if many separate networks need to be connected to each other, or if networks that need to be connected are not physically contiguous.

■ **Figure A-1** How a backbone network is used



In the Figure A-1, example A shows five networks connected serially by routers, with no backbone. To get from Network 1 to Network 5, a packet would need to travel four hops, and to contend with network traffic on the three intervening networks—which may themselves be slower-speed networks.

In contrast, in example B, the same transmission would need to travel only two hops, with the backbone network in between. (Network performance can be further enhanced if that backbone is a high-speed network.)

Selecting the backbone network type

Any type of network that can be connected to a router can be set up as a backbone. However, since the object of a backbone is to enhance performance—and since the backbone may be used as a throroughfare for many connected networks—it's desirable for the backbone network to transmit data at a fast rate.

For example, any type of backbone can provide the efficiency of fewer hops between networks, but an Ethernet backbone will also provide a high transmission speed. The usage levels and performance needs of your own internet should dictate your backbone selection.

It's important to note that network nodes can be connected directly to a backbone network, permitting heavily-used devices such as file servers to become more efficiently accessible to networks connected to the backbone.

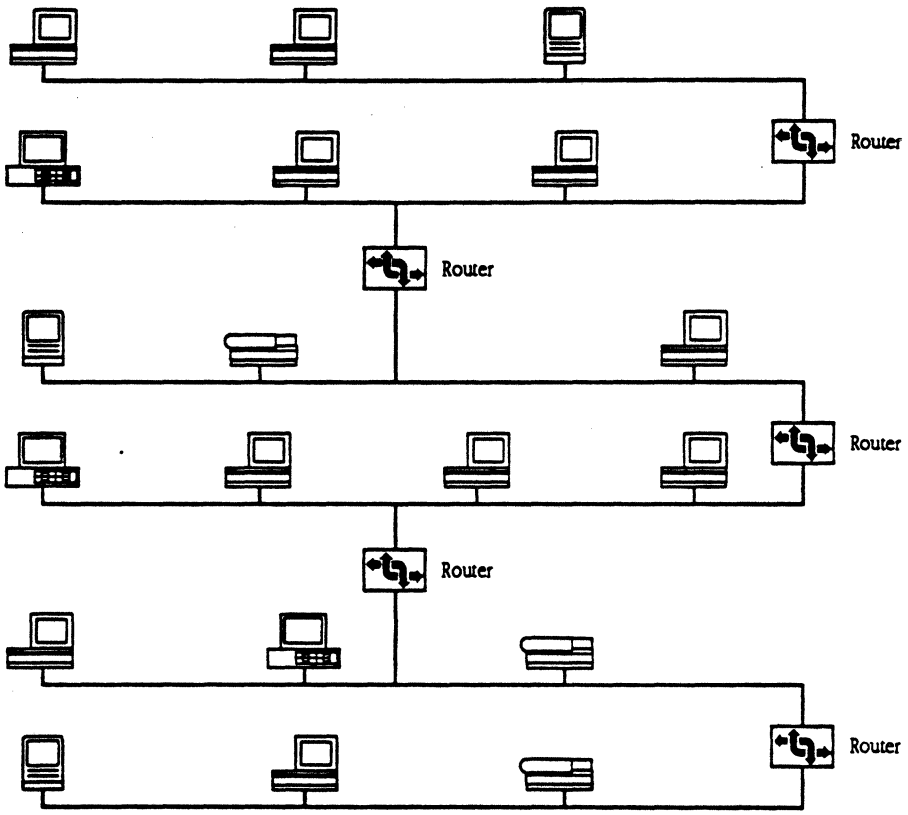
Where to place a router

Each internet is, in some ways, unique: The connected networks can differ in size, layout, and type. Provided a router is properly connected, there are no absolute rules that govern the placement of routers in your internet. However, the following guidelines for router placement can help you to improve the performance of your internet.

Selecting a router location on each network

A router may be placed at any point in the length of a network. It isn't necessary to connect networks end-to-end. As shown in Figure A-2, a router can be the endmost device on a network, or it can be located anywhere along the network cable.

■ **Figure A-2** Sample router locations

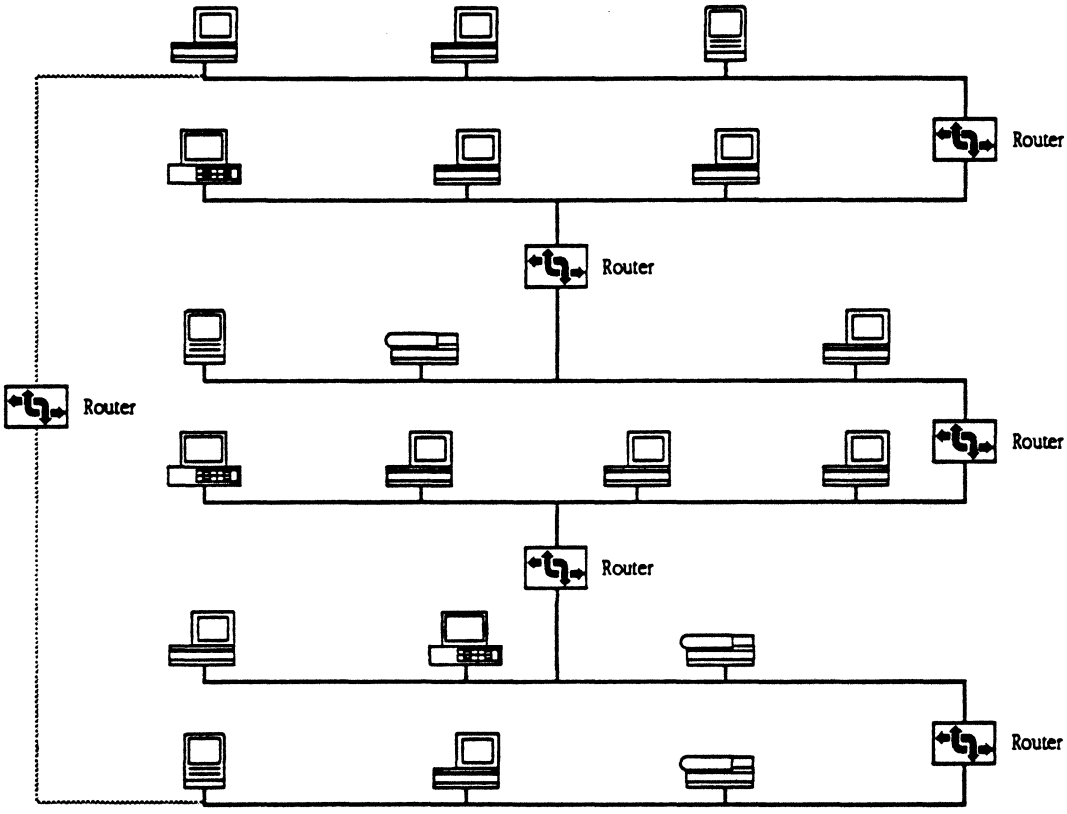


Creating redundant routes

Where possible, try to create duplicate routes to each individual network. Using this technique, called **redundant routing**, you can prevent these networks from becoming inaccessible to the rest of the internet if a break should occur on one of their access routes.

In Figure A-3, a router has been added to the internet to produce circular redundancy, creating an alternate access route between any two networks and improving network reliability.

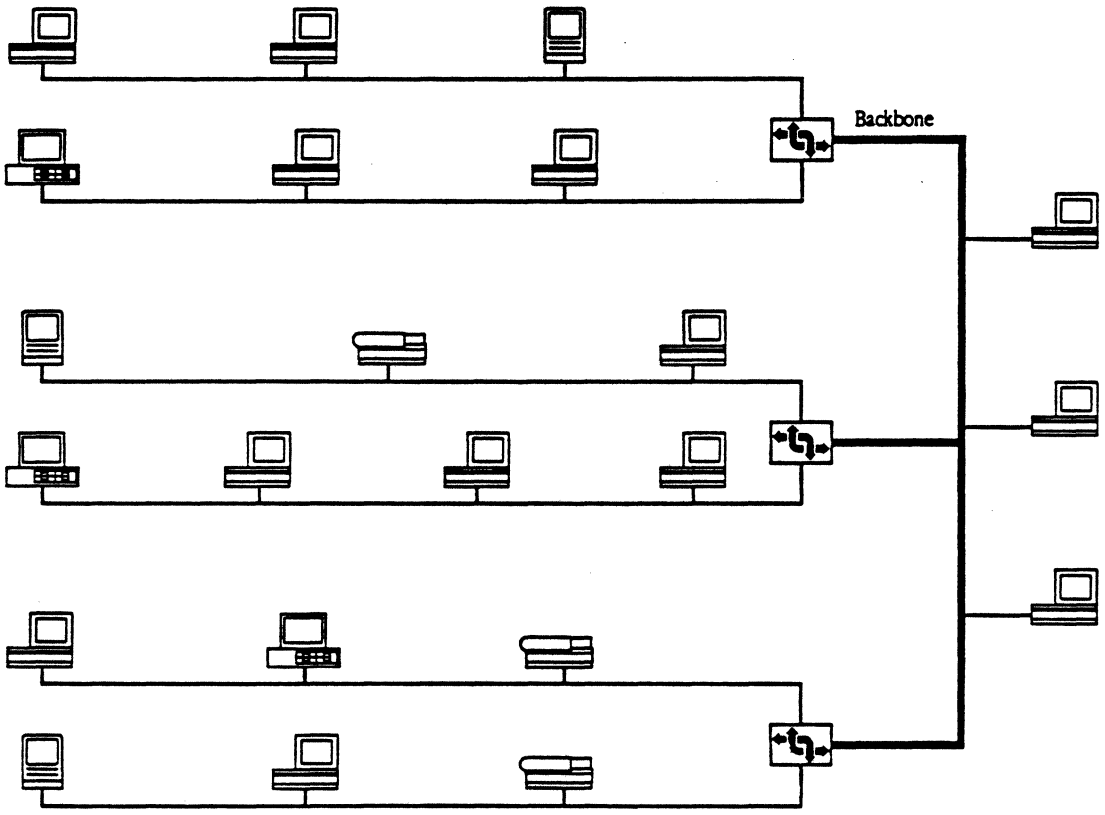
■ **Figure A-3** A redundant route layout



Adding backbone networks

As described in the earlier discussion of backbone networks, a backbone gives each connected network a more direct route to every other network, with the minimum possible number of hops. A large internet can contain a framework of several backbone networks connecting all other networks.

■ **Figure A-4** Network independence through backbone design

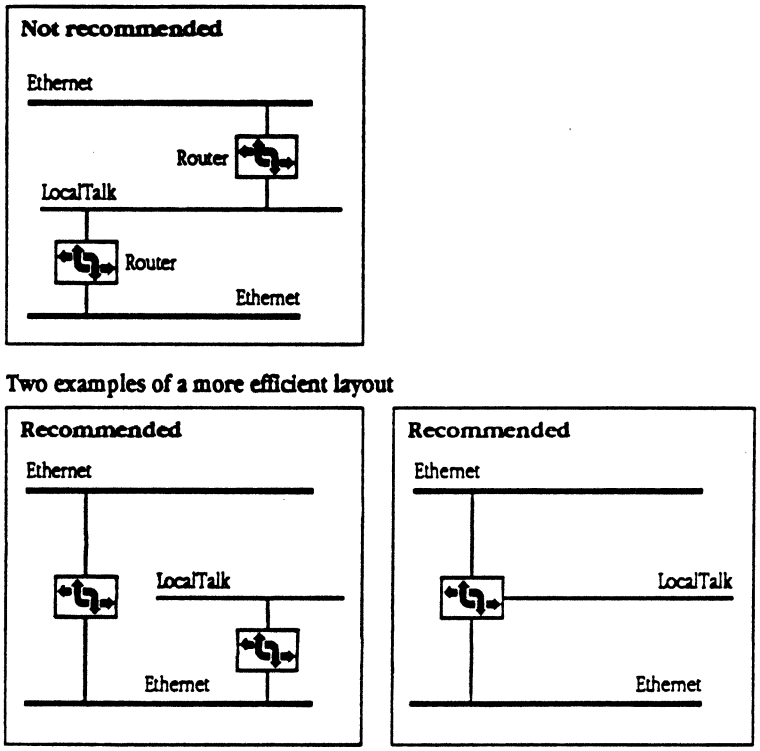


If a break should occur on any individual network (other than the backbone), other networks can maintain uninterrupted communication, independently of the inactive network.

Relative network speed

Since you may combine different types of networks in an AppleTalk internet, you need to consider *where* it would be most advantageous to place higher speed networks in the layout of your internet. When possible, avoid placing slower networks in a busy route between other networks.

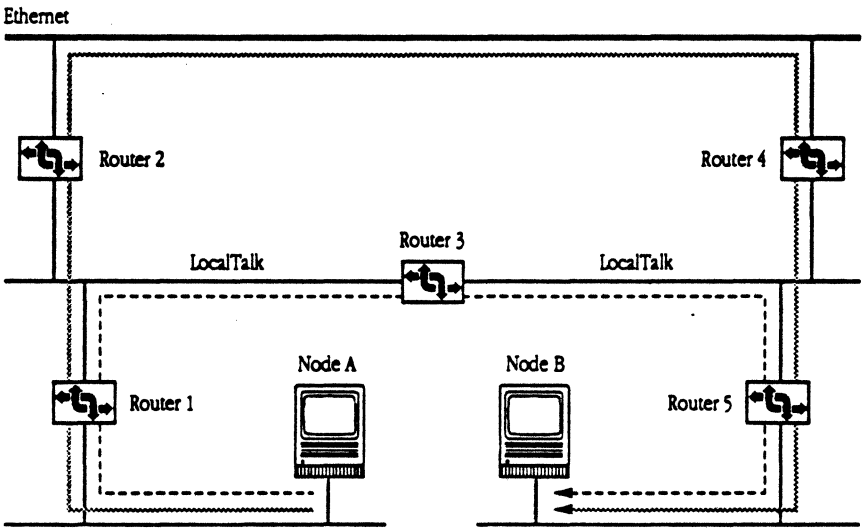
■ **Figure A-5** Laying out the internet for optimum performance



When connecting networks of different speeds, consider that the router does not distinguish the speed of a network when selecting a route to a destination; it favors the route with the least number of hops.

Wherever redundant routes exist, try to place fewer hops in the faster network so that this will be the path selected. You may want to eliminate redundant routes where their hop counts will cause the router to favor the slower-speed route. This is illustrated in Figure A-6.

■ **Figure A-6** How some redundant routes can interfere with routing efficiency



In this internet, Router 1 will forward a packet through the shorter, 3-hop route, even though it is slower. To prevent this, eliminate the redundant route by removing Router 3.

Assigning network numbers, ranges, and zones

The procedure for assigning numbers and names to networks and zones is described in Chapter 6, "Setting Up the AppleTalk Internet Router." The format you use to identify networks is subject to a few restrictions, such as the length and maximum value of network numbers, but it is otherwise determined by your own preferences and conventions, not by any specific rules.

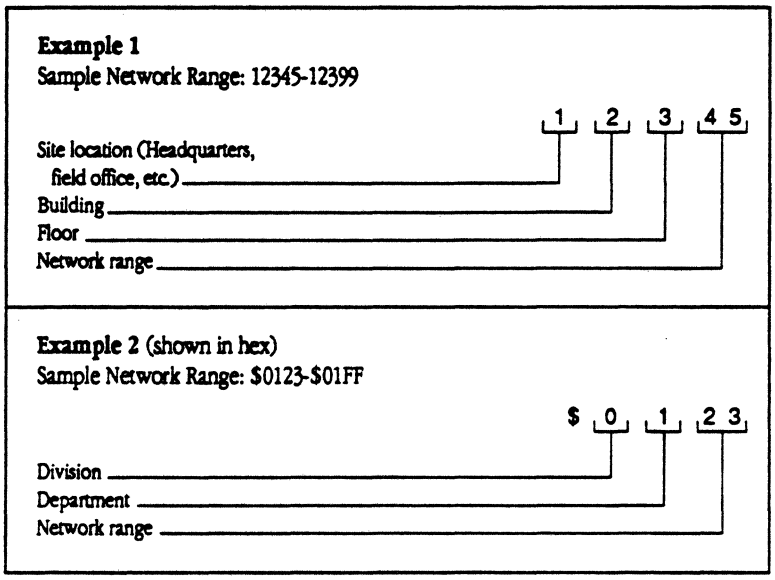
However, observing certain guidelines in how you identify networks can help to maintain order as the internet grows and the number of networks and zones increases. These guidelines are described in the following sections.

Assigning network numbers

In large and fast-growing internets, it's useful to observe a consistent network numbering system—a special format for the creation of network numbers.

Such a system involves assigning a location code or department code to the digits in a network number. The examples in Table A-1 illustrate how a network numbering system can help to identify networks in an orderly way.

■ **Table A-1** A sample network numbering system



A network numbering system serves three purposes:

- It facilitates the assignment of network numbers when new networks are created.
- It gives a meaning to each network number, so that an administrator can look at a routing table or other network listings and associate the network numbers with their physical counterparts.
- It allows networks that are not currently connected to be merged into the internet in the future without causing network number conflicts.

Assigning network ranges

If a network containing more than 253 AppleTalk nodes is to be connected to an AppleTalk Internet Router, or if a network in your internet is expected to grow beyond 253 AppleTalk nodes in the future, you must assign a *network range* to that network.

When assigning a network range, be sure the size of the range allows for ample network growth.

For example, in a network containing 1000 nodes, the range 1–4 would accommodate current needs (4 x 253 nodes = 1012), but would allow only 12 free node addresses for future growth. Exceeding this level of growth would require you to shut down the router and assign a new, larger network range, disrupting network services to users.

The recommended guideline in choosing a network range is to allow capacity for at least twice the current number of nodes, and more if rapid growth is anticipated. Since an AppleTalk internet supports up to 65,279 network addresses, or over 16 million possible node addresses (65,279 x 253 nodes), it's possible to assign oversized network ranges and still have sufficient addresses for a very large internet.

Example:

A single EtherTalk network connecting 300 nodes is to be connected to an AppleTalk Internet Router, and the network is expected to grow by 30% in a year.

Choosing the range:

A network range containing two network numbers would support the anticipated year's expansion. However, similar growth in the following year would require you to change the setup of all the network's seed routers.

A network range containing at least four network numbers is recommended for this network.

For further flexibility in your internet setup, when assigning network ranges, allow wide margins between the ranges you select. For example, if a range of 100–110 is assigned to a network, you may want to start the next range with network number 120 rather than network number 111. If your internet has relatively few networks, margins between network ranges can be very large.

Creating AppleTalk zones

AppleTalk network zones and zone lists are defined in Chapter 2, "AppleTalk Terms and Concepts."

There are two principal objectives in creating multiple zones for the internet:

- to balance the number of network services presented to users
- to support the creation of departmental work groups

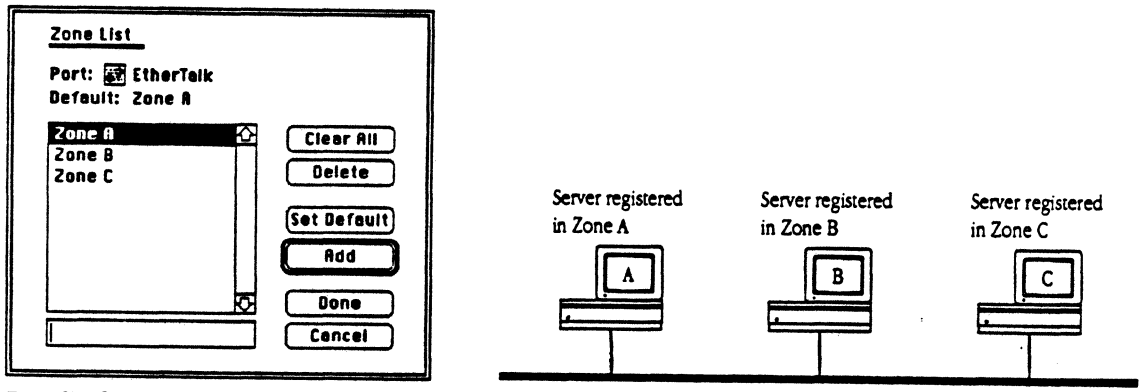
Creating zones to balance network services in the internet

Through the Chooser desk accessory, a network workstation presents lists of all the available printers and servers in a given zone. These include file servers, print servers, and mail servers. The user selects desired services from these lists.

In an internet having hundreds or thousands of nodes, if all nodes were in the same zone, the listings of available servers presented to users would be extremely long and cumbersome to use.

Defining multiple zones can create a balance between the number of users and the number of servers available to them. Figure A-7 illustrates this concept

- Figure A-7 Balancing services through AppleTalk zones



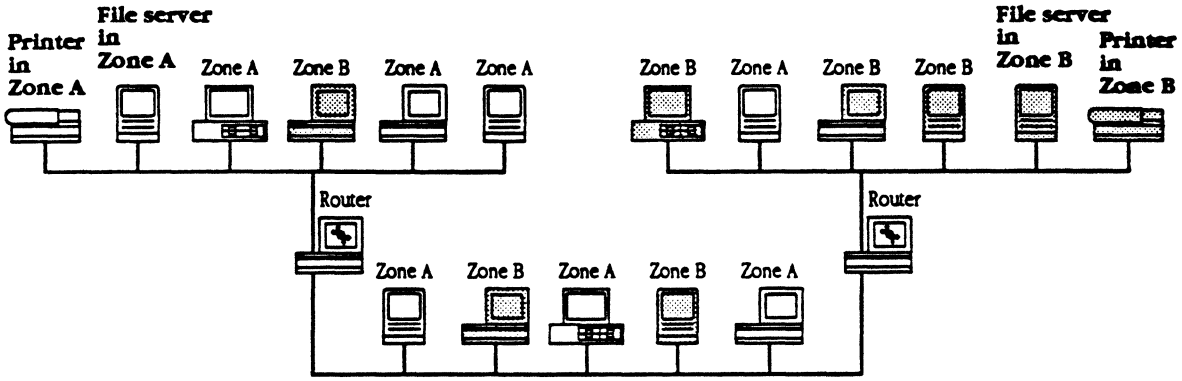
Zone list for Network 1

Network 1

Creating zones to facilitate departmental grouping

A group of users assigned to the same zone can efficiently share the network resources in that zone. But since a department's boundaries do not necessarily correspond to a physical network cable, a zone list can add flexibility to the creation of work groups by allowing users on the same physical cable to be in different zones. Figure A-8 illustrates this point.

■ Figure A-8 How zones help users on different physical networks share services



APPENDIX B

Effects of the AppleTalk Internet Router on Network Nodes

THIS APPENDIX DESCRIBES CONDITIONS UNDER WHICH A NODE ON AN APPLETALK network may be affected by the operation of a router.

If unexpected network-related conditions are encountered by network nodes while the router is operating, consult the network troubleshooting guidelines in Chapter 11 of this guide, and the owner's guides of the affected node hardware and software.

The AppleTalk Internet Router's operation is generally transparent to users of network nodes. However, the presence of an active router may require action from a node's user or administrator when the node *first* detects the presence of the router. This may occur on one of two occasions:

- when the node is first connected to the network
- when a router first becomes active on the network

Connecting a node to a network

When any node is connected to an AppleTalk Phase 2 network *for the first time*—if routers are to be used on that network—then at least one seed router should be active on the network.

If, for any reason, *no* router is active when the node is first connected to the network, then once a router does become active, the node's AppleTalk connection may need to be reestablished before the node can communicate with the rest of the internet. Reestablishing the AppleTalk connection allows the node to acquire a new network address that is consistent with the router's setup.

The next section, "Reestablishing a Node's AppleTalk Connection," describes how to reestablish the AppleTalk connection on a Macintosh node. This may be necessary under two conditions:

- If the node has never previously been used on an AppleTalk Phase 2 network, its AppleTalk connection will need to be reestablished before any internet services can become available to it.
- If the node has been moved from another network where an AppleTalk Phase 2 router was running, the node may have saved its prior network address, which will conflict with the new address. The node's AppleTalk connection should be reestablished *immediately*. Otherwise, the node may lose access to all local network and internetwork services.

In either condition, when a router does become active on the network, the node may display an alert message indicating that the user must reestablish AppleTalk in order to use internet services.

Reestablishing a node's AppleTalk connection

Follow the instructions below to reestablish the AppleTalk connection on a Macintosh node:

1. **Open the Control Panel.**

   Choose Control Panel from the Apple menu.

2. **Click the Network icon.**

   The Control Panel displays an icon for each AppleTalk connection available on this node.

3. **Click the icon for the desired AppleTalk connection.**

   If there is a zone list for this node, it is displayed.

4. **Press Return to confirm the node's zone.**

5. **Close the Control Panel.**

The AppleTalk connection is reestablished.

Selecting a node's zone

If a zone list is entered in the setup information for a network, each node on the network can belong to any zone in this list. LocalTalk networks are always associated with a single zone name rather than a list, so no zone selection is performed for LocalTalk nodes.

A node's zone is generally selected from the network's zone list when the node is connected to the network for the first time, and can be changed at any time.

Since not all nodes are capable of displaying a zone list (for example, certain non-Apple computers), a node will reside in the default zone for its network unless a zone is explicitly selected for the node.

The default zone for a network is selected by the network administrator during router setup, when entering the network's zone list. It is the first entry made in the zone list, unless the network administrator designates a different zone as the default zone.

△ **Important** Once a node's zone has been selected, it's not necessary to select it again each time the node is started up. The node's zone name remains saved until it is changed by the user or administrator. △

To select a Macintosh node's zone:

1. **Open the Control Panel.**

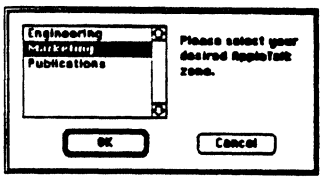
   Choose Control Panel from the Apple menu.

2. **Click the Network icon.**

   The Control Panel displays an icon for each AppleTalk connection available on this node.

3. **Click the icon for this node's AppleTalk connection .**

If the selected AppleTalk connection is EtherTalk or TokenTalk, a zone list is displayed.



4. **Select the zone for the Macintosh node.**

   The node's currently selected zone is displayed. To change this selection, click the desired zone name in the list.

5. **Click OK or press Return.**

6. **Close the Control Panel.**

   The procedure is completed, and the node now belongs to the selected AppleTalk zone.